April 18, 2014

Transmittal Letter for Tripp-Umbach Report:
"Evaluating the Feasibility of a New College of Medicine in Urbana-Champaign"

Dear Colleagues:

As you may have heard, the University of Illinois at Urbana-Champaign and the Carle Healthcare System jointly commissioned a study on the feasibility of developing a new medical college at Urbana-Champaign. We are pleased to share the results of this study with you. Our two institutions recruited Tripp Umbach to analyze the feasibility of developing an engineering-focused medical college jointly owned and governed by Carle and the university. Tripp Umbach is a national leader in feasibility analysis, economic impact studies and consultation services for universities, hospitals, academic medical centers and biomedical organizations.

We commissioned this feasibility study for two major reasons.

First, the U.S. healthcare system is undergoing historic transformation driven by an aging population with more chronic conditions, an influx of millions of new people into the healthcare system due to the Affordable Care Act, and a severe physician shortage. In addition, the convergence of engineering, technology and medicine will lead to discoveries that will result in greater access to better healthcare at lower cost for more people. Studying how to best address this new reality is consistent with Carle's mission to serve people through high quality care, medical research and education.

Second, the university's *Visioning Future Excellence* initiative identified health and wellness, information and technology and economic development as three of the themes the university should focus its investments upon in order to meet society's greatest challenges http:// http://oc.illinois.edu/visioning. The Business Cluster Development report identified biomedical and bioengineering as a technology cluster that would enhance economic development in our region http://go.illinois.edu/technologyclusterdevelopment. However, that report states that the lack of a full-scale medical program prevents us from realizing the potential economic development impact of this cluster.

Illinois and Carle each would bring unique strengths to a different model for a college of medicine:

- There is no U.S. public research university better positioned than Illinois to leverage the convergence of engineering with medicine and be a leader in the transformation of health care research, education, practice and delivery. The Urbana campus already has the assets, including one of the nation's top-five engineering schools and the National Center for Supercomputing Applications. All of the top 10 medical schools in the country already partner with faculty members at the Urbana campus in the College of Engineering and the Computer Science and Genomics programs. Yet, the university does not have its own medical college on campus to take advantage of these opportunities. Additionally, the campus receives more annual funding from the National Science Foundation than almost any other institution.

- As the only health system in Illinois that owns its own health plan, and one of the state's largest providers of clinical care, Carle is a leader in high quality, cost-effective and better-coordinated patient care. That allows improvements in systems of care, rather than focusing in one area of healthcare delivery – a capability that has led to Carle being consistently recognized among the best in the state and the nation. This structure allows flexibility to rapidly advance care delivery through programmatic

changes, early adoption of technology and research. As a physician-led and patient-centered organization, Carle can maximize this model to provide the best outcomes possible for patients.

Tripp Umbach reviewed many approaches and ultimately recommends developing a specialized engineering-based medical college in Urbana-Champaign that would be the nation's first medical school designed for the express purpose of fusing engineering, computing, health sciences and medicine. It would train physician-scientists to shape the future of healthcare delivery, practice and technology. This specialized engineering-based medical college would advance health care and improve patient outcomes. It would grow the state's biotech sector and serve as an international magnet for innovation and scholarship. Investment and new jobs would flow into Illinois at a faster pace.

We are excited by these findings and, in coming months, will analyze and interpret the initial recommendations along with additional information to be developed. As part of the process it will be necessary for our respective governing bodies to consider and approve the important initiative. We hope you will take time to review the report, which is available at: go.illinois.edu/collegeofmedicinestudy.

Phyllis M. Wise, Chancellor, University of Illinois at Urbana-Champaign

James C. Leonard, MD, President and CEO, The Carle Foundation

April 17 | 2014

Evaluating the Feasibility of a New College of Medicine in Urbana-Champaign

Analysis and Recommendations

Final Report

Prepared By:

TrippUmbach
Research • Strategy • Impact

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I. Introduction

In January 2014, Tripp Umbach was retained jointly by the Carle Health System and the University of Illinois Foundation to conduct a feasibility assessment to identify the costs, opportunities, and benefits of establishing a four-year medical education program at the University of Illinois at Urbana-Champaign.

This report includes key findings and recommendations for the most feasible college of medicine program. This study allows leaders at the Carle Health System and the University of Illinois at Urbana-Champaign, as well as regional and state government, education, health care, industry, and economic development partners, to better understand the costs and benefits associated with the development of a four-year college of medicine on the flagship campus of the state's largest public research university.

II. Project Overview

This study was developed by Tripp Umbach, with active engagement by the Carle Health System and the University of Illinois at Urbana-Champaign, to meet the following objectives:

- Explore the advantages and disadvantages, as well as the cost and benefits of developing various medical school models.
- Conduct an analysis of the clinical and educational capacity of the Carle Health System and the University of Illinois at Urbana-Champaign, as well as other institutions statewide, to develop a new medical school.
- Develop a feasibility study report document to allow the Carle Health System and the University of Illinois to make an informed decision regarding the implementation of a

This report provides the research, data analysis, and insight to allow partner institutions to make an informed decision regarding moving forward with a new medical education and research program in Urbana-Champaign.

potential college of medicine in Urbana-Champaign and the associated fundraising implications.

- Develop an assessment of the potential economic impact of the "most feasible" college of medicine, profiling the multiple economic benefits associated with the operations of a new college of medicine, as well as clinical, research, and commercial spinoff activities on the Urbana-Champaign region and the state of Illinois.

The health care industry is undergoing transformative change due to many factors, including unsustainable increases in costs, an aging patient and physician population, a primary care provider shortage, and the need to shift from a medical education and health care delivery system focused on providing episodic care to one designed to prevent and manage disease. The future of health care requires that patients, providers, academic institutions, community organizations, and industry work together in innovative ways to provide high-quality care with better outcomes at lower costs.

The community of Urbana-Champaign is unique in its ability to address these challenges. It contains not only a leading research-based university, but also a high-quality, fully integrated health care delivery and financing system. The University of Illinois at Urbana-Champaign and the Carle Health System recognize the potential to leverage this advantage to shape the future of health care through the development of a medical education enterprise.

To determine the feasibility of various options for this development, these organizations retained the services of Tripp Umbach, a Pittsburgh-based consulting firm. Tripp Umbach is the national leader in conducting feasibility analysis and economic impact studies for academic medical campuses and for new or expanded medical schools. Tripp Umbach has provided consultation and analysis services to almost every new or expanded medical school over the past 10 years, and has completed individual studies for more than 75 academic medical centers. Since 1995, Tripp Umbach has completed national studies measuring the economic impact of 130 medical schools and more than 400 teaching hospitals for the Association of American Medical Colleges (AAMC). Tripp Umbach's extensive experience makes the firm the most qualified to assess the feasibility and economic impact of a new college of medicine.

To determine the feasibility of a new medical enterprise in Urbana-Champaign, Tripp Umbach conducted interviews with leaders throughout Illinois, including stakeholders representing higher education, health care, industry, and government. More than 40 individuals from over a dozen entities were engaged. Interviews were conducted not only in Urbana-Champaign, but also in Peoria and Chicago. Detailed listings of the individuals and organizations are listed in Appendix A.

Incorporating findings from these interviews, Tripp Umbach analyzed the feasibility of three specific models of medical education development, including the development of a specialized engineering-based college of medicine in Urbana-Champaign through a corporate structure created by the Carle Health System and the University of Illinois at Urbana-Champaign, the development of a new college of medicine through stronger alignment with UIC College of Medicine, and the development of a larger regional college of medicine with partner hospital systems in both Urbana-Champaign and Peoria. These models are described in greater detail in Section V of this report.

The most critical success factor in the development of a new college of medicine is the presence of motivated project leaders who believe that the new college of medicine will benefit existing academic institutions, health care providers, community residents, and the economic development of the region. Additional factors necessary for successful development include engaged faculty and clinicians interested in teaching and research, facilities and resources to provide education and scholarship opportunities, the ability to provide the appropriate breadth and depth of clinical experiences to students, and the financial support to start the new school and sustain operations in a manner which satisfies the accrediting body of allopathic medical schools in the United States, the Liaison Committee on Medical Education (LCME).

During the 1980s and 1990s, no new medical schools were developed in the United States. In 2006, growing concern over physician shortages led the Association of American Medical Colleges (AAMC) to issue a policy statement calling for a 30 percent increase in medical school enrollment. Since then, 15 new medical schools have been established, and more are in development. Notably, four new medical schools (Hofstra North Shore-LIJ, Oakland William Beaumont, Virginia Tech Carilion, and University of South Carolina-Greenville) have recently been established as a result of a partnership between an existing university and a major health system. Each of the health systems already had extensive experience providing both undergraduate and graduate medical education. This factor helped address one of the most difficult challenges faced by new medical schools—the ability to provide the appropriate breadth and depth of clinical experiences.

Based upon Tripp Umbach's extensive experience with the development of new medical schools, its feasibility analysis of a new college of medicine enterprise in Urbana-Champaign, and the recognition of universal support among key stakeholders, Tripp Umbach believes that the model outlined in the following report provides the best opportunity to change the way health care is delivered throughout Illinois and the nation. Most importantly, the existing strengths of the University of Illinois at Urbana-Champaign and the Carle Health System, as well as the two partners' collaborative energy and dedication to the transformation of health care, are significant indicators of the long-term success of the proposed medical enterprise.

CONSULTANT SUMMARY

Tripp Umbach recommends the development of a specialized engineering-based college of medicine in Urbana-Champaign through a corporate structure created by the Carle Health System and the University of Illinois at Urbana-Champaign. This specialized engineering-based college of medicine would ideally admit its first students in the fall of 2017, and would aim to revolutionize the delivery of health care through the integration of advanced technology, transform the quality and efficiency of regional health care delivery, strengthen the university statewide, grow statewide bioscience economic development, and serve as an international magnet for innovation, research, and scholarship. Tripp Umbach cautions that the institutions must move quickly to implement this recommended program to advance Carle Health System as a premier national health care leader and to allow the University of Illinois to maintain its position as an international leader in engineering and other technology-based research.

Recommendation #1: Develop an independently-accredited college of medicine through a private governance structure.

After completing a comprehensive review of options outlined below in this report, Tripp Umbach recommends that the Carle Health System and the University of Illinois at Urbana-Champaign form a private organization to serve as the foundation for an independently-accredited research, technology, and engineering-focused four-year college of medicine at the University of Illinois at Urbana-Champaign, with the Carle Health System and the University of Illinois at Urbana-Champaign serving as equal partners in teaching, research, clinical education, and commercialization of new discoveries. Students of the new school will graduate with a degree awarded by the University of Illinois at Urbana-Champaign, but governance of the school will be achieved through a partnership between Carle Health System and the University of Illinois at Urbana-Champaign.

Tripp Umbach recognizes that these two organizations already partner on multiple levels and have exceptional opportunities to expand clinical translational research and to continue their strong partnership in medical education through a joint college of medicine. Tripp Umbach recommends that a name that incorporates both partners be established immediately to avoid confusion with the current UIC College of Medicine. This new school will replace the existing regional campus structure in which the University of Illinois Urbana-Champaign campus trains 125 M1, 25 M2, 25 M3, and 25 M4 students who receive a medical degree from the UIC College of Medicine. Tripp Umbach recommends that the new college of medicine, through a contractual relationship with the UIC College of Medicine, continue to train 100 M1 students who will complete M2 through M4 at regional

campuses in Peoria and Rockford and who will receive a medical degree from the UIC College of Medicine when they graduate.

Tripp Umbach recognizes the following strengths of the two founding partners as critical to the development of the groundbreaking new college of medicine:

- **Carle Health System** – Carle's integrated health care system is already a model for effective and efficient health care delivery, focusing on the patient while incorporating teaching and research in its daily operations. Comprised of a 345-bed tertiary care hospital, a critical access hospital, a 380-member employed physician group practice, and a 325,000-member health plan, the Carle integrated system is designed to deliver high-quality affordable health care focused on improving health outcomes in a fiscally responsible manner for 1.5 million residents. As a fully-integrated health system, Carle has the capacity, data, and provider base to transform health care delivery. Carle's model ensures that the continuum of primary and specialty care, whether delivered in an outpatient or inpatient setting, is built upon utilization of a system-wide electronic medical record, application of evidence-based medicine, and focus on patient safety and satisfaction and continuous quality improvement.
 - Health care systems are being developed across the country as the preferred delivery model for patient care. Utilizing a health system model that partners physicians and patients across the continuum of care improves care coordination, reduces redundant testing and increases patient satisfaction. A critical component of care coordination is optimizing the use of technology through electronic health records (EHRs) that are accessible to all providers and patients. Carle has deployed the use of an EHR system across multiple locations and services, and its patients are encouraged to engage in "e-health" services. Developing an engineering-based medical school with a partner that is a leader in implementing and using technology to coordinate care and empower patients is a unique opportunity that Carle can provide.
 - A common theme in discussions of how to improve the current health care system is maximizing data. Data fragmentation frequently occurs in health care delivery because information about patient care cost and utilization is often housed on a payor's system and is not accessible to providers for the evaluation of cost-effective care models. By owning a robust insurance company, Carle is able to achieve what most other providers cannot – access to utilization and cost of care data. Carle's ability to teach future physicians about data-driven decision-making and innovation based on big data will be a key asset for the new engineering-based medical program.

- Because Carle Health System has a provider-owned insurance company, all components of delivering care are merged. This allows physician training to occur in an environment where physician, patient, and payors' incentives are aligned to provide appropriate care in a manner that is efficient and cost-effective. Carle's fully integrated health system, including the insurance company, enables flexibility across all aspects of the organization to develop compensation models that align goals for improved health outcomes, patient satisfaction, appropriate use of resources, and a full continuum of care. Furthermore, Carle's insurance company data can be used to support the cost-effectiveness of evidence-based team patient care.
- Complementing Carle's approach to the delivery of medical care is Carle's long-term commitment to medical education and research. Through its residency programs in Family Medicine, Oral and Maxillofacial Surgery, and General Surgery, and its partnership with the University of Illinois' Internal Medicine residency program, Carle trains physicians in an integrated health care delivery system that prepares physicians for practicing medicine in a quality-driven, technologically-advanced, innovative, and efficient environment. Supporting this commitment is a robust Continuing Medical Education (CME) program for physicians, nursing education programs, and training programs for ancillary technicians.
- The Carle Research Institute is focused on translating medical knowledge into practical applications for patients. Carle physicians, nurses, residents, and scientific research partners from other entities, including the University of Illinois at Urbana-Champaign, are currently engaged in 107 research studies and are working together to support numerous clinical trials to translate lab discoveries into practical applications for better patient care. Current research projects include optical medical imaging, traumatic brain injury, and genomic diagnostics in cancer. Carle's integrated model, including clinical care teams, electronic health records, data analytics, and a health insurance company, provides a laboratory where research, education, and quality patient care combine to transform health care.

- **University of Illinois at Urbana-Champaign** – The University of Illinois at Urbana-Champaign is consistently ranked among the top five universities in National Science Foundation (NSF) funding. A new engineering-focused college of medicine based in Urbana-Champaign will immediately be positioned to bring new federal, corporate and foundation support into the region for innovative multidisciplinary research involving patients, scientific research, and advanced technology-driven solutions.
 - The College of Engineering is among the highest ranked Colleges of Engineering in the nation and is actively engaged in engineering innovations for medicine. It is highly sought after as a

partner for pursuing the integration of engineering and medicine. For example, the Mayo Clinic has chosen the University of Illinois at Urbana-Champaign College of Engineering as its primary technology and genomics partner after a rigorous evaluation of other top engineering schools. Additionally, the top 10 United States medical schools as ranked by total federal funding from the National Institutes of Health (NIH) also have ongoing research collaborations with engineering and science faculty at the University of Illinois at Urbana-Champaign.

- The University of Illinois at Urbana-Champaign is a comprehensive research-intensive university. Thus, while the new college of medicine would be engineering-based, it will draw on new and extraordinary opportunities for collaboration with other colleges to infuse technology-based medicine in their educational and research missions. For example, the new college of medicine could partner with Applied Health Sciences to develop technology-based solutions for health care delivery for the growing elderly population. Additional partnerships could include quantitative biology and biotechnology-based collaborations with Liberal Arts and Sciences, as well as novel partnerships with Veterinary Medicine, Agriculture and Consumer and Environmental Sciences, the Division of Nutritional Sciences, and Social Work.
- The University of Illinois at Urbana-Champaign has the elements necessary not only to pursue discoveries and innovations, but also to facilitate their adoption and commercialization. Many colleges and faculty members can support the design, applied health assessments, and behavioral and social elements related to adoption of medical innovations. The University has a faculty determined to develop an innovative engineering-centric and team-centric curriculum that will transform innovation among students. The University will also be able to leverage its research park and startup ecosystem to create pipelines of biotech companies and to partner these companies with an extensive industrial biosciences network of state and national enterprises.
- The University of Illinois at Urbana-Champaign will be able to leverage excellent facilities, including the Blue Waters supercomputer and the extensive imaging facilities available at the Beckman Institute, as well as robotic, data visualization, and cybersecurity test beds found in different multidisciplinary units of the University and the College of Engineering. In addition, a major Electrical and Computer Engineering building will be completed in late 2014, and Everitt Laboratory will become fully renovated space for the Department of Bioengineering in 2015-2016. The current facilities housing the existing college of medicine are also undergoing major renovations. Finally, land exists for a future medical research campus to be created.

- The University of Illinois Urbana-Champaign already has well established connections with Carle. This includes bridges established through the Division of Biomedical Sciences, the Mills Breast Cancer Institute, the Carle Neuroscience Institute, and departments with faculty affiliates with well-established connections with colleagues at Carle. These provide a strong foundation for the partnership's success.

This unique public-private medical school, organized as a private entity, has the advantage of shared governance and risk, as well as the flexibility to add multiple partners and adapt to rapid changes in health care, education, and science. The model also allows partners to avoid conflicts with the UIC College of Medicine, the state's publically supported college of medicine that currently trains more physicians (largely primary care physicians) than any other medical education program in the United States. As outlined in greater detail in this report, medical education and research in the State of Illinois, which has lost ground to other states over the past 15 years, will be strengthened by multiple collaborations with the new highly specialized independent college of medicine at the University of Illinois at Urbana-Champaign.

While Tripp Umbach recommends that the majority of the Board of Directors for the new college of medicine represent health care, education, civic, business, and industry leaders from the Urbana-Champaign community, in order to facilitate collaboration and coordination between the UIC College of Medicine and the new college of medicine, Tripp Umbach also recommends that the Board of Directors for the new independent college of medicine include the Vice Chancellor for Health Affairs and Dean of Medicine of the University of Illinois at Chicago College of Medicine. Other Director positions should include a dean of an existing "aspirational peer" medical school and a representative from the Chicago business community.

Recommendation #2: Ensure that the new college of medicine is built on an innovative engineering- and diverse team-centered curriculum and housed within a unique educational and translational science facility that leverages the collective strengths of the founding partner institutions.

Tripp Umbach recommends that the new college opens in the fall of 2017 with 25 students in the initial class and grows to 50 students per class within the first six years of operations. Many of these medical students are expected to also be enrolled in PhD programs in majors such as bioengineering, material science engineering, electrical and computer engineering, computer science, molecular and cellular biology, biochemistry, and other quantitative life sciences. Numerous opportunities for additional joint degrees will be possible. The new college of medicine will be the first in the nation to differentiate itself based upon collaboration between medicine, engineering, technology, and quantitative sciences, providing it with an immediate competitive advantage over existing national and international schools of medicine. While similar university and health system models are being developed in Austin, Texas, Roanoke, Virginia, and Greenville, South Carolina, none of these new medical school projects have the degree of integration that is possible in the recommended model. Further, the University of Illinois at Urbana-Champaign, a member of the American Association of Universities (AAU), is a stronger research university than either the University of South Carolina or Virginia Tech, and Carle provides an integrated health care delivery model that is not available in any of the aforementioned markets.

Tripp Umbach believes that a small, highly specialized medical school, developed through a public-private partnership between the University of Illinois at Urbana-Champaign and the Carle Health System, is preferable to a traditional, clinically-focused, multi-hospital distributed training model focused on meeting physician workforce needs. The development of a highly innovative curriculum, which prepares physicians trained in critical thinking, analytical approaches, and the ability to deliver appropriate care in an inter-professional, patient-centered environment with ready access to the next generation of sensors, data mining tools, materials, imaging, genomics, and robotics, will produce physician-scientist and physician-engineer leaders who will train future community-based-physicians who graduate from other medical schools, including the UIC College of Medicine, throughout the United States and internationally.

Tripp Umbach recommends that the curriculum for the new college of medicine build upon the University of Illinois at Urbana-Champaign campus' top-rated engineering- and science-based research programs to train physician-engineers and physician-scientists engaged in biomedical research that fully integrates state-of-the-art and future technological innovations in the curriculum to ultimately improve care and outcomes. The curriculum will include inter-professional training and practice interfaces with colleges and schools on Urbana-Champaign campus and with multiple partner educational institutions throughout the region, state and nation. It is

recommended that this new college of medicine be a leader in team-based education and service delivery. The commercialization of the college of medicine's innovations will be an economic development engine for the state of Illinois as faculty and graduates of this new program will be likely to start locally based biotechnology companies which provide jobs and other economic benefits. Additionally, the new school should benefit from its investment in intellectual property developed by faculty at the new college of medicine. A portion of new revenue generated through school and faculty contracts with third-parties, licensing, and consulting will be reinvested to strengthen the new college of medicine.

The University of Illinois at Urbana-Champaign College of Engineering has already contributed major advances in biomedical engineering. Current research poised to revolutionize primary and surgical care includes:

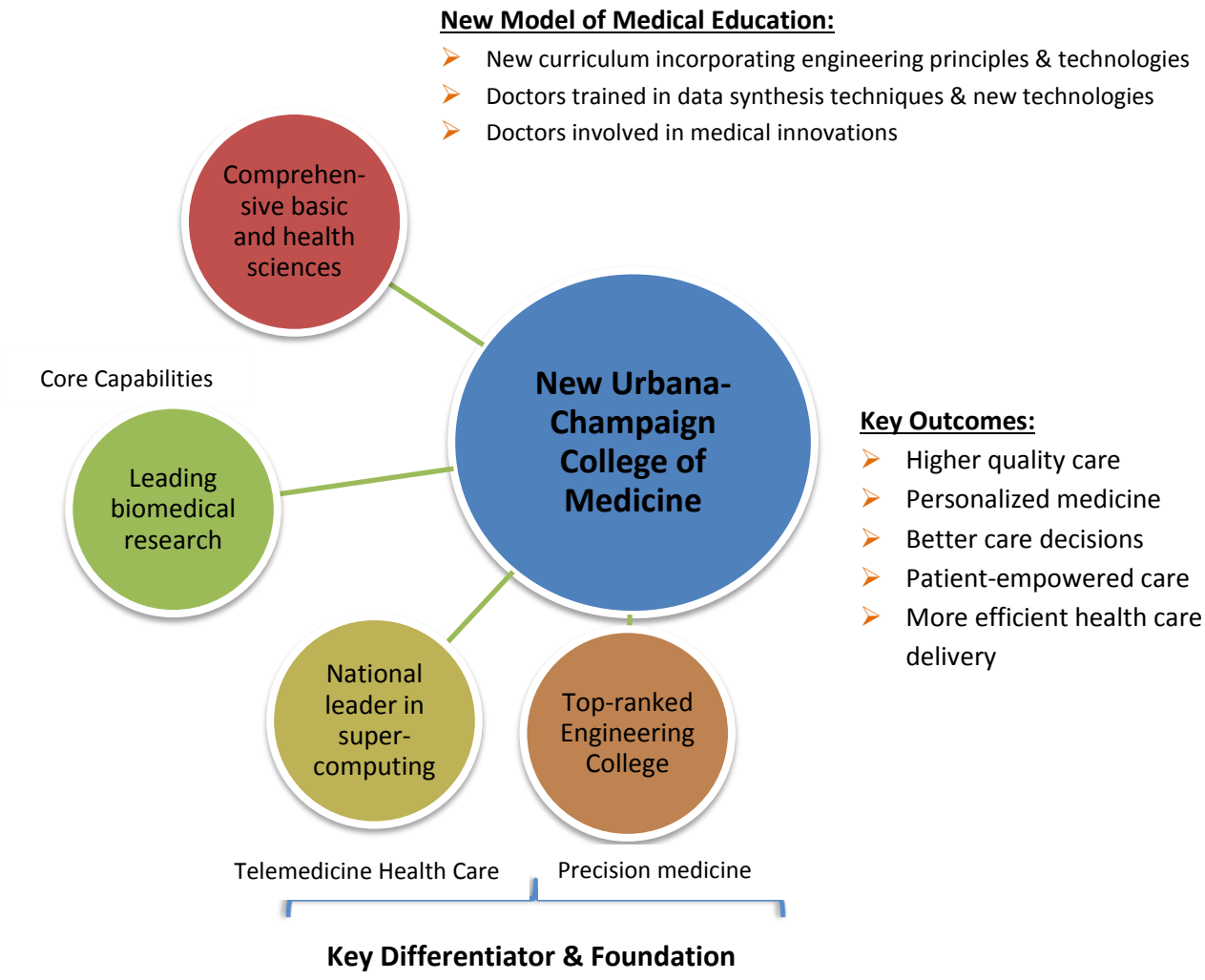
- ✓ Flexible silicon semiconductors to monitor body functions
- ✓ Biodegradable electronics technology for use in medical implants
- ✓ Mobile phone-based portable diagnostics
- ✓ Advanced real-time high resolution imaging during surgery
- ✓ Handheld systems for detection of infections
- ✓ Biological soft micro-robotics for drug screening and chemical analysis

The new college of medicine will leverage these existing strengths to train physicians with clinical experience to collaborate effectively with engineers, computer scientists, lawyers, business leaders and other professions. This collaboration will enable effective research and facilitate the application of trans-disciplinary theory to attack diseases that have the greatest impact on health status and cost of care, including cancer, cardiovascular disease, and neurodevelopmental and neurodegenerative diseases.

Physicians graduating from the new school will launch their future residencies, research, and clinical careers with new strengths in quantitative methods, engineering, and technological platforms, as well as strong biological and clinical backgrounds.

Tripp Umbach recommends that the new college of medicine evolve over time as the anchor of an interdisciplinary, research-intensive medical campus, with medical students engaged in self-directed dual-degree programs in engineering and other programs that may be developed or expanded in the future. A medical education facility, including advanced technology, rich inter-disciplinary research labs, incubation space for start-up companies, and a state-of-the-art simulation center, will be needed eventually. While built to accommodate 50 medical students in each class, this science and engineering-based facility will have spaces that promote inter-disciplinary and inter-professional education, research translation, and commercial application – within a unique, industry-changing facility.

Image 1: New Model of Medical Education



Recommendation #3: Expand the capacity within the two partners to ensure long-term sustainability of the new medical school.

Medical Education Enhancements

While a business plan will be developed in 2014 and application for accreditation by the Liaison Committee on Medical Education (LCME) will be finalized in 2015, Tripp Umbach recommends the following hiring plan for the new college of medicine:

- The new college of medicine should begin in 2015 with the recruitment of a founding dean, who must be a nationally recognized leader in engineering and science-driven medicine.
- In 2016, the founding dean will lead efforts to recruit and/or retain five assistant professors, five full professors, 20 clinical research faculty, and 20 clinical teaching faculty, to teach students and conduct research in collaboration with clinical partners at the Carle Health System and educational partners throughout the University of Illinois at Urbana-Champaign, especially the College of Engineering. In addition, Tripp Umbach recommends that the new college of medicine secure 12 additional staff members to provide accreditation, fundraising, administrative, and student support, as well as services related to finances and student admissions.

Clinical Education Enhancements

Planning for a successful new college of medicine in Urbana-Champaign will require the development of new training sites and a commitment to the highest quality clerkships and residencies for students. In addition to Carle Health System's four high-quality residency programs, Tripp Umbach recommends that the new college of medicine expand clinical training capacity for undergraduate and graduate medical students, residents, and fellows through the development of funds and effort policies to support Carle Health System physicians for increased commitments to research and teaching. Currently, Carle Health System provides approximately 63 percent of all clerkships to Urbana-Champaign-based medical students, as indicated below, and it is recommended that the new college of medicine continue to have an open faculty model to encourage physicians and health care providers from other facilities and groups to participate in the teaching of medical students: (Table 1)

Table 1: Clerkship Experiences 2008 to 2013

Site	Number Clerkship Experiences	Percent
Carle Foundation Hospital	738	0.57
Presence Urbana	198	0.15
Presence Urbana/VA	51	0.04
Carle/VA	40	0.03
Christie (all sites)	24	0.02
VA	23	0.02
Carle/Presence Urbana	20	0.02
Private Offices C-U	17	0.01
Carle/Christie	11	0.01
Bloomington Bromenn/Carle	7	0.01
Danville Presence	7	0.01
Pavilion	6	0.00
Carle/Danville Presence	5	0.00
Bloomington Bromenn	4	0.00
Philo Clinic private	4	0.00
Frances Nelson	4	0.00
Christie/Presence Urbana	3	0.00
Bloomington Bromenn/Christie	2	0.00
Danville/Bloomington Bromenn	2	0.00
Gibson City	2	0.00
Carle/Frances Nelson	1	0.00
Monticello Kirby	1	0.00
Paxton	1	0.00
Other Medical Schools	134	0.10

Tripp Umbach also recommends that a compensation and effort deployment model be developed at the Carle Health System to recognize and reward physician faculty for their increased efforts in teaching and new research collaborations anticipated with the creation of the new medical school. The development of methods to support physicians in their academic efforts through dedicated time for research and training is imperative for the college of medicine model to be successful. In return for this investment, the new college of medicine will attract high-quality physicians seeking clinical and/or research positions at the University of Illinois at Urbana-Champaign and the Carle Health System. It is also important that faculty from the University of Illinois at Urbana-Champaign be encouraged and supported as they engage in joint research with physicians and other providers at Carle Health System.

Graduate Medical Education Expansion

The new college of medicine's ultimate success is related to its ability to develop a regional Graduate Medical Education Consortium that would augment the Carle Health System by engaging additional hospitals and community physician and provider groups statewide, to expand the residency training opportunities available in the Urbana-Champaign region for college of medicine graduates. It is important to note that the overall goal of the new college of medicine is to produce practicing physician-scientists, and each graduate of the new college of medicine will need to complete an accredited graduate medical education (residency) program. Partnerships with other large established teaching hospitals in the State of Illinois are imperative for clinical education, as support for expanded GME offerings may require resources outside the current Carle Health System. Therefore, the final business plan must include a plan to address the need for additional graduate medical education opportunities for graduates of the new medical school.

Recommendation #4: Ensure that the new college of medicine has the flexibility to develop and expand multiple relationships with other health care, education, and industry partners nationally and internationally for the benefit of strengthening the founding partners and the economic impact to the state of Illinois.

The model recommended within this report identifies two founding partners. However, successful schools of medicine nationwide have capitalized on relationships with external health care and industry organizations to ensure their teaching, research, and patient care goals are met. Therefore, in addition to the University of Illinois at Urbana-Champaign and the Carle Health System, Tripp Umbach recommends a focused effort on engaging others in the community, region, and nation (such as the Mayo Clinic) to be involved in meeting the goals of the college. An example of a current relationship that demonstrates the interest external organizations have in each of the founding partners is the partnership between the Mayo Clinic and the University of Illinois at Urbana-Champaign. The Mayo Clinic designated the University of Illinois at Urbana-Champaign as its primary technology and genomics partner after a rigorous evaluation of other top engineering schools. Likewise, Carle Health System has demonstrated its ability to provide care and training for niche patient populations through its clinical care and teaching relationships with the Children's Hospital of Illinois. Further, the collaborative model of medical education and leveraging relationships outlined in this report will have the greatest potential to attract research revenue from the National Institutes of Health (NIH), other federal agencies, corporations, and foundations, especially in light of recent prioritization of team-based research. The University of Illinois at Urbana-Champaign is consistently among the top five universities in National Science Foundation (NSF) funding,

but ranks in the mid-70s in NIH funding. A new engineering-focused, collaborative college of medicine based in Urbana-Champaign will bring new federal dollars into the region and the state.

Recommendation #5: Ensure that the new highly-specialized college of medicine does not duplicate the existing UIC College of Medicine, but instead allows for extensive collaboration with the existing college of medicine.

As mentioned above, the development of an engineering-based school of medicine provides opportunities for complementary rather than competitive learning experiences for future physicians in the State of Illinois and provides opportunities to collaborate and expand Illinois presence in medical education and research. A key element in ensuring the success of the new school of medicine in support of the ongoing success of the existing UIC College of Medicine is to engage the University's Vice Chancellor for Health Affairs and Dean of Medicine as members of the Board of Directors for the new medical school. Involving University of Illinois leaders across medical school programs will ensure maximum collaboration and the greatest potential to increase NIH funding opportunities for the University of Illinois.

Tripp Umbach also believes that the development of a new private college of medicine in Urbana-Champaign provides an opportunity to enhance the existing College of Medicine in Chicago. As the new school is created, the UIC College of Medicine, already training the most diversified body of future practitioners in the nation, has the opportunity to leverage new technologies, through collaborations with the proposed new college of medicine in Urbana-Campaign, to establish itself as the national leader for addressing issues related to diversity in the health care industry and the delivery of urban health care services with an emphasis on addressing the needs of minority populations.

Tripp Umbach believes that by not requesting support from state General Revenue Funds (GRF) for the new college of medicine in Urbana-Champaign, more financial support will be available for the existing UIC College of Medicine. This support will allow the existing College of Medicine to take advantage of the emerging revolution in medicine, driven in large part by engineering innovations which are already transforming the ability to deliver drugs and develop health protocols targeting specific populations. Tripp Umbach believes that the Dean and staff at the existing UIC College of Medicine are in an ideal position to develop a strong partnership with the proposed independent college of medicine to:

- Conduct clinical trials that must address the diversity of physicians and their patients.
- Adapt and tailor bioengineering innovations to urban health care needs and conditions.

- Conduct clinical trials involving diverse populations in partnership with biotechnology start-up companies emerging from the new College of Medicine and based both in the Urbana-Champaign area and in the Chicago region.

In summary, the new independent college of medicine provides an opportunity for the existing University of Illinois Chicago College of Medicine to develop areas of strength and distinction while it pursues a broad education mandate spanning issues related to urban health, rural health, multiple locations and academic tracks, comprehensive research, and economic development both in Chicago and statewide. The partnership between the established public College of Medicine and a new engineering- and technology-focused college of medicine will allow each school to improve recruitment efforts for top students and faculty, as well as enhance philanthropic initiatives that are aligned with each school's distinct character.

Recommendation #6: Develop a detailed business plan that includes a sustainable funding model that does not require General Revenue Fund appropriations for medical education.

A detailed financial model and fund development strategy is required before the college of medicine program can be implemented. Detailed analysis of income and expenses will be required in a full business plan and financial model. Tripp Umbach recommends that such a business plan and financial model be completed on or before September 2014 to meet the timetable to open the new college of medicine in the fall of 2017.

Based upon Tripp Umbach's expertise as well as available data related to financial models for current and planned medical schools, Tripp Umbach recommends using the following broad parameters associated with a feasible new medical school:

- $75 million over five years to cover start-up costs for the new school.
- $25 million for initial facility upgrades during the start-up phase.
- A 200,000-square foot, highly-specialized college of medicine facility, costing approximately $100 million, depending on configuration and equipment, to open in 2025.
- $22 million in annual revenue to cover annual operating expenses when the school admits its first students in 2017, and $47 million in annual revenue to cover annual operating expenses when the school is fully operational in 2021.

Tripp Umbach recommends that significant resources from private sources be secured to start and grow a successful venture. In addition to the $100 million required for the start-up phase, an endowment with a corpus

of approximately $200 million to ensure the long-term viability of the enterprise is necessary, as the school will need operational funding support each year to cover a funding gap between expenses and tuition, grants, contracts, and clinical revenue. While public medical schools have taxpayers to cover funding gaps, the new college of medicine will need to develop a foundation to address the lack of public funding. It is estimated that the new school, with small class sizes and an associated PhD program, must generate approximately $8 million in additional funding annually before revenue from expanded clinical growth, expanded research, and reinvestment from commercial applications is fully realized. Additional funding will be needed from the Carle Health System, the University of Illinois at Urbana-Champaign, and external private donors to support the college of medicine program between 2021 and 2035.

Tripp Umbach recommends that the new college of medicine obtain revenue from the following sources:

- Tuition
- Grants and Contracts
- Clinical Revenue Sharing
- Philanthropy
- Commercial Revenue

It is also recommended that the financial plan include the development of a bioscience reinvestment fund created through income from a portion of earnings from the licensing of commercial applications of discoveries and the generation of incremental research revenue. These funds could be used for strategic program growth in key areas that support the mission of the new college of medicine. Recognizing that the new college of medicine is intended to enhance the national and international reputations of founding partners, external research awards and philanthropic contributions will be reported in such a way as to maximize reputational growth for each partner.

III. VALUE OF A NEW ENGINEERING- AND TECHNOLOGY-BASED COLLEGE OF MEDICINE SCHOOL

Value to the Carle Health System and the Community it serves:

The new college of medicine will further Carle Health System's mission of serving people through high-quality care, medical research, and education, and provides Carle with the opportunity to be the leader in transforming teaching, further integrating technology and medical research, providing team-based clinical education, and supporting its mission through commercialization of discovery. The new college of medicine will strengthen Carle's ability to serve as a tertiary clinical provider and advance the health of the population in the region.

- A new college of medicine located in Urbana-Champaign will provide Carle Health System with significant benefits related to new expertise of providers who will deliver care to patients of the health care system. Most importantly, the new school will create an environment to train and facilitate the development of physician leaders who will drive the necessary transformation from volume-driven, reimbursement-based care to value-driven care delivered through advanced technology and collaborative teams of providers.
 - This transformation, and its impact on cost and quality, will be especially important to Carle Health System as it manages all aspects of patient care within its delivery system, including its own health insurance company.
 - The partnership between Carle Health System and the University of Illinois at Urbana-Champaign will enable the new college of medicine to integrate education, innovation and patient care to address changes in health care delivery as a result of advances in technology and societal financial constraints.
- Carle's physician and research teams will partner with engineering experts to develop technologies that are critical for delivering high-quality and effective health care in the future. These technologies are anticipated to enhance Carle's current practice of evidence-based medicine for improving health, and to increase access to information to improve population health through ambulatory-based preventive medicine.
 - In addition to graduating physicians who will remain in Illinois to practice, the new college of medicine will attract and retain high quality clinicians who are interested in research as well as clinical care and choose to practice in an academic health center setting that allows them to do

both. This physician workforce impact is especially important in light of projected physician shortages due to the impact of the Affordable Care Act and the aging physician and patient population.

 - Working in collaboration with nurses, allied health professionals, surgical technicians, and community colleges, the new college of medicine will also have a direct impact on the creation of a multi-layered workforce.

- Carle Health System, along with the University of Illinois at Urbana-Champaign, will become a destination for health care, offering primary and specialty care similar to the type of care found in premier medical communities nationally.
- Clinical trials conducted by the new college of medicine, in addition to Carle's existing clinical trials, will provide value to the Urbana-Champaign community, as well as an advantage to Carle Health System. These trials will position the health system as a destination for care by providing patients with access to cutting-edge treatments typically not available at non-academic health centers.
- Connection to engineering research provides opportunities for breakthrough research in medical devices, technology, clinical trials, and patient care models. The health system will offer innovative state-of-the-art care that draws national attention and enhances its reputation. Through this connection, Carle Health System will create new national best practices in clinical care and develop better preventive medicine protocols and population health management capabilities.
- Carle Health System will develop new technologies and teaching methods based on a team-based fully integrated health care model with a medical school, clinics, hospitals, and provider-owned insurance company (the only one in the state of Illinois).
- Carle Health System, along with its research partners, will be the springboard for future economic development in Urbana-Champaign and throughout the State of Illinois. These partnerships have the opportunity to launch new industries and add value to existing industries, creating high-paying jobs in health care, higher education, and related industries.

 - As a major employer in the Urbana-Champaign community, it is critical that Carle Health System maintains its ability to be a national leader in health care and to remain fiscally viable. The new college of medicine will allow Carle to continue its commitment to diversify, adapt to change, and be a strong community partner.

Value to University of Illinois at Urbana-Champaign:

- A core mission for the University is economic development. The new college of medicine is seen as important to the University's ability to contribute to the economic development of not only the Urbana-Champaign area, but also Central Illinois, Chicagoland, and the State of Illinois. The new college of medicine will enhance the University's ability to attract and retain faculty, research funding and conduct translational research to transform knowledge and creativity into economic growth for the state.
- The well-being and quality of life of the University will be improved through the development of the new college of medicine. A wider array of health services and cutting-edge clinical trials will improve the health care options of our employees and the larger community. Economic growth and job creation will inevitably lead to greater opportunities for dual-career couples, better transportation infrastructure, improved services, and other quality of life measures.
- A core mission of the University is education. Creating an independent college of medicine based on engineering and technology in Urbana-Champaign will provide the region with a quality academic physician training program which will address the current and future health care issues of the region and beyond.
 - The integration and development of innovative and cutting-edge technology will be embedded in the future of medicine through the preparation of new physician-engineers and physician scientists. It is projected that these new physicians will elevate the image and the profile of the University of Illinois on a grander scale.
 - Newly graduated physicians will be trained to understand technology and its interaction and implications within medicine. Physicians from the new college of medicine will help shape new standards of patient care and treatment methods. They will also be trained to work in multidisciplinary teams utilizing team-centric approaches that are optimized to deliver better health care in a more efficient manner to patients both locally and nationwide.
- Engineering and computational pre-eminence represents a 150-year mark of excellence for the University of Illinois at Urbana-Champaign, and the convergence of engineering and medicine dictates that the future of engineering schools will be tied to their integration with health care research and development. Co-locating the new college of medicine and the College of Engineering on the same campus will ensure the integration of engineering and technology-based health sciences and will provide the College of Engineering with a competitive advantage relative to cutting-edge research and

superior educational experiences. The location of the new college of medicine on the same campus as the College of Engineering will also attract funding resources and leverage the assets of both schools. In particular, the University will be able to capture significant research funding currently going to the top College of Medicines who are partnering with the College of Engineering.

- Close engagement with Carle physicians in integrated teams and clinical settings will expose the faculty and students to critical health care issues. This exposure will guide research and innovation toward objectives that will have maximum impact and benefit to society. Furthermore, the partnership will enable access to Carle's comprehensive and integrated financial and clinical data, allowing extensive data analytics, knowledge management, and computational science discovery with specific application to transforming health care delivery and outcomes.
- The new college of medicine will provide an immediate competitive advantage. The private partnership with a partner equally committed to the delivery of better health care at lower costs will be unique and distinct from the start. Furthermore, the proposed partnership will provide the flexibility and nimbleness required for the partnership to respond quickly to changes to stay ahead of its academic peers.
- The new college of medicine will allow the University of Illinois at Urbana-Champaign to strengthen its competitive position among its aspirational peers. Among the University's top 10 ranked public research university peers, UC Berkeley and the University of Texas at Austin are the only other institutions that do not have colleges of medicine. The University of Texas at Austin is in the process of acquiring a college of medicine, and UC Berkeley has strong connections to the nearby UC San Francisco and Stanford Colleges of Medicine, as well as a large and established School of Public Health, which competes effectively for NIH funding, on its campus.

Value to UIC College of Medicine:

- The delivery of medicine has been significantly transformed by engineering innovations and the ability to develop health protocols targeting specific populations. The UIC College of Medicine will be in an ideal position to:
 - Become the new school's partner for clinical trials involving diverse populations and conducted by biotechnology start-up companies based in Urbana-Champaign and Chicago. These clinical trials will address the diversity of physicians and their patients.
 - Become the new school's partner in adapting innovations to urban health care needs and conditions.

- Become the new school's partner, through its Peoria and Rockford campuses, in adapting innovations to rural health care needs and conditions.

- Increased partnership and collaborative opportunities will allow for additional NIH funding potential for the school and the state overall.

- The new college of medicine provides an opportunity to transform the state's medical education system into two strongly defined schools, each with its own unique focus and purpose.

 - The new partnership will allow for improved recruitment of top faculty and students and an associated improvement in philanthropic activities. Both efforts will contribute to the University's mission and strategic objectives.

Value to State of Illinois

- The new college of medicine will provide additional federal research opportunities and development funds for the state of Illinois.

 - The new college of medicine will attract federal funding for the state of Illinois, which currently ranks 17th in the nation for the amount of federal research and development dollars received annually ($2.6 billion in 2010 according to a study by the Rand Corporation), as well as for the University of Illinois, which currently ranks 8th in the nation ($1.2 billion in 2010).

- The new college of medicine will build on the foundation established by the University of Illinois Research Park and the newly created Digital Manufacturing and Design Innovation Institute, and will therefore strengthen the development of a vital Urbana-Champaign-Chicago corridor of technology innovation as an economic development driver for the State of Illinois.

- The new college of medicine and the recently announced ARCHES partnership between OSF Healthcare and the College of Engineering at the University of Illinois at Urbana-Champaign will initiate the creation of an I-74 Medical Innovation Corridor through collaboration with health care systems in Urbana, Peoria, Champaign, Bloomington, Normal, and Danville.

 - The Corridor will be an incubator to help create high-paying jobs and make the entire region more attractive to major companies and medical technology industries.

 - The location of the new college of medicine in this Corridor offers an opportunity to apply engineering-driven innovation to transform rural health care services.

- The new college of medicine will establish itself and the State of Illinois as the national leader in medical innovation and technology.
 - The Illinois Medical District (IMD), University of Chicago, Northwestern University, UIC College of Medicine, and Loyola University, along with Chicago-based investments in technology infrastructure, have created the foundation for the state to become the national leader in medical innovation and technology. The new college of medicine in Urbana-Champaign will further solidify Illinois' position.
- Academic medical centers are currently collaborating with the University of Illinois at Urbana-Champaign because of its engineering and technology expertise. A new college of medicine in Urbana-Champaign will allow talent and expertise to remain in Illinois.
 - Colleges of Medicine at Stanford University, Johns Hopkins University, Washington University, Duke University, and Vanderbilt University—all top 10 medical schools as ranked by the National Institutes of Health (NIH) funding-- have developed ongoing research collaborations with University of Illinois at Urbana-Champaign engineering and/or science faculty. A new college of medicine will create partnerships on the same campus with University of Illinois at Urbana-Champaign faculty, keeping faculty talent and expertise in the state of Illinois.

IV. SUPPORT FOR RECOMMENDATIONS

Key Finding #1: The state of Illinois lags behind other states in academic medicine and bioscience economic development.

As part of the feasibility study, Tripp Umbach conducted an assessment of the strength of the academic medical industry, both statewide and in Chicago, compared with other states and metropolitan areas. The analysis was conducted using two national databases, both developed by Tripp Umbach on behalf of the Association of American Medical Colleges (AAMC). The two national databases include: 1) The total economic impact of all U.S. allopathic medical schools (2012) and 2) The total economic impact associated with federal biomedical research on all 50 states (2011).

These databases and comparative reports, which have been maintained and updated by Tripp Umbach and the AAMC since 1995, provide the most accurate data available for making comparisons on the size of the academic medical industry as a whole and specifically on federally-sponsored biomedical research.

State by State Academic Medical Industry Impact Rankings

While the state of Illinois ranks 7th among all states relative to the total economic impact of academic medicine, generating $28.7 billion in total economic impact in 2012 (AAMC), other states with similar populations generate a significantly higher economic impact. For example, Pennsylvania generates an annual impact of $47 billion, a 50 percent greater impact than Illinois. The economic impact of academic medicine in the smaller state of Massachusetts was $38.8 billion in 2012. The table below depicts the economic impact of academic medicine for the top 10 states. (Table 2)

Table 2: Economic, Employment, and Government Revenue Impact for AAMC Members (2012)

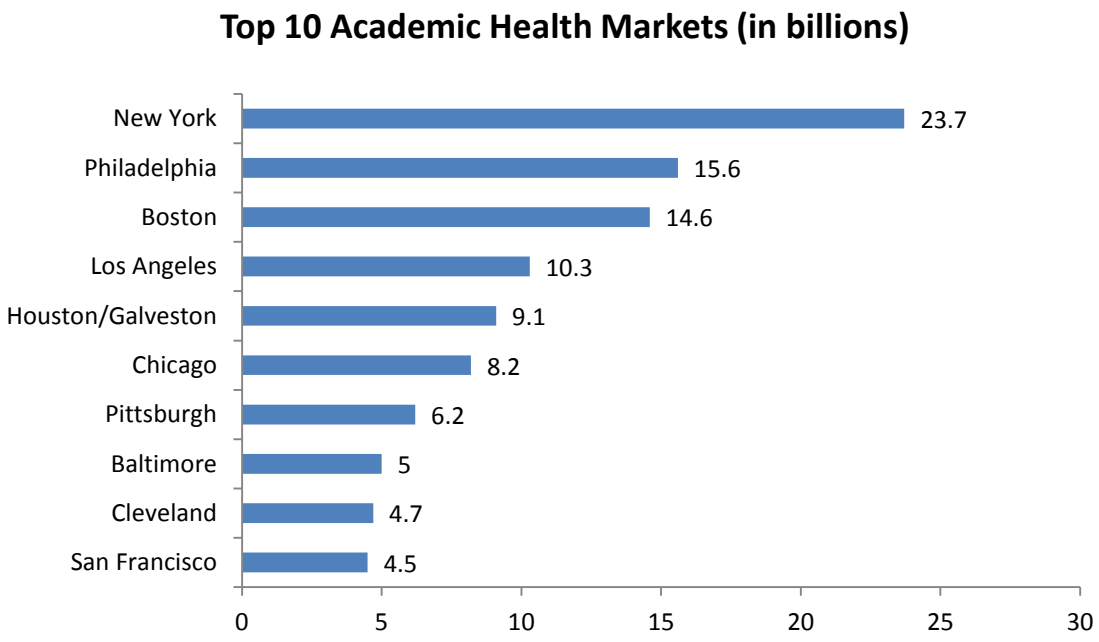
States	Rank	Total Economic Impact	Total Employment Impact	Total Government Revenue Impact
New York	1	$74,151,538,606	430,743	$4,819,032,979
California	2	$49,201,512,761	264,046	$2,921,073,540
Pennsylvania	3	$47,033,121,373	272,640	$2,882,702,406
Massachusetts	4	$38,760,110,682	195,154	$2,234,308,702
Texas	5	$35,825,649,773	228,513	$1,327,689,312
Ohio	6	$32,314,079,590	209,047	$1,884,550,734
Illinois	7	$28,732,944,479	155,233	$1,478,370,705
Florida	8	$24,490,233,642	166,676	$1,211,629,554
Michigan	9	$23,051,327,122	133,120	$1,585,794,455
North Carolina	10	$17,330,838,088	120,578	$ 942,220,251

Note: Since 1995, the states of Texas and Ohio have surpassed Illinois in total economic impact.

Academic Medical Industry Rankings by Metropolitan Area

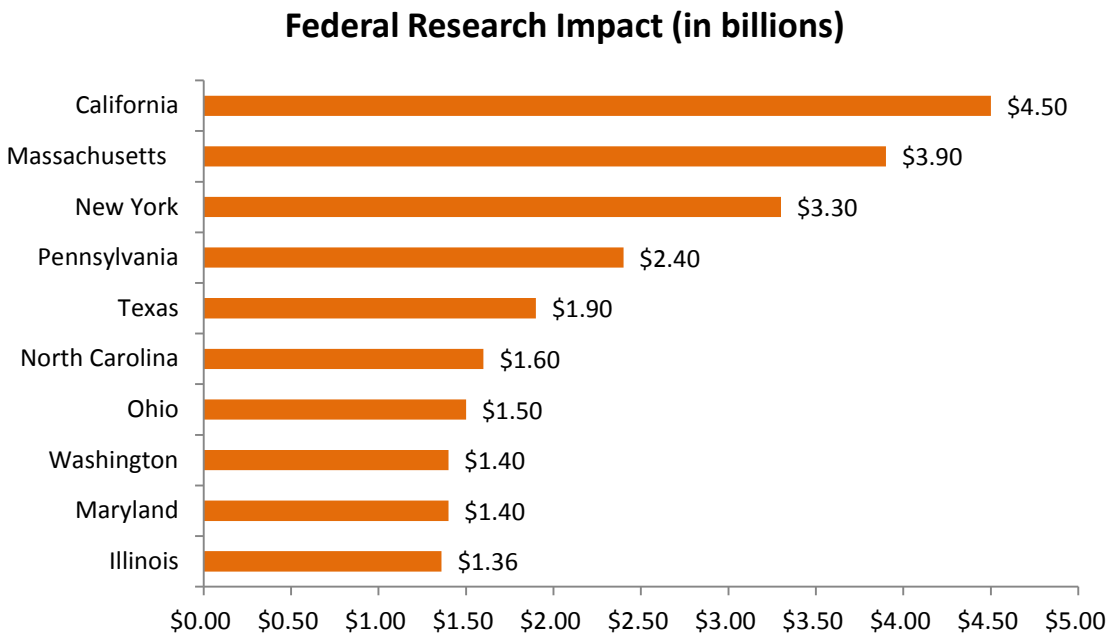
Tripp Umbach also compared the economic impact of academic medicine at the metropolitan level and found that Chicago had the 6th largest academic medical center industry cluster in 2012, as measured by the combined economic impact of all medical schools and teaching hospitals on the regional economy. In 1995, Chicago was the 4th largest metro area; Houston and Los Angeles surpassed Chicago over the past 15 years. In 2012, AAMC estimated the total economic impact of all academic medicine in metropolitan Chicago at $8.2 billion. The largest markets, as measured by the total economic impact of academic medicine, are New York ($23.7 billion), Philadelphia ($15.6 billion) Boston ($14.6 billion), Los Angeles ($10.3 billion) and Houston ($9.1 billion). (Chart 1)

Chart 1: Top 10 Academic Health Markets



While the size of the economic impact associated with academic medicine in Chicago is larger than the impact of smaller metropolitan areas such as Pittsburgh ($6.2 billion), Baltimore ($5 billion), and Cleveland ($4.3 billion), the economic impact of academic health is significantly larger on a per capita basis in these smaller markets. Perhaps most telling in terms of the need to add a new research-intensive college of medicine at the University of Illinois at Urbana-Champaign is that the State of Illinois ranks 10th among all states relative to the economic impact associated with federally-sponsored research. (Chart 2)

Chart 2: Federal Research Impact



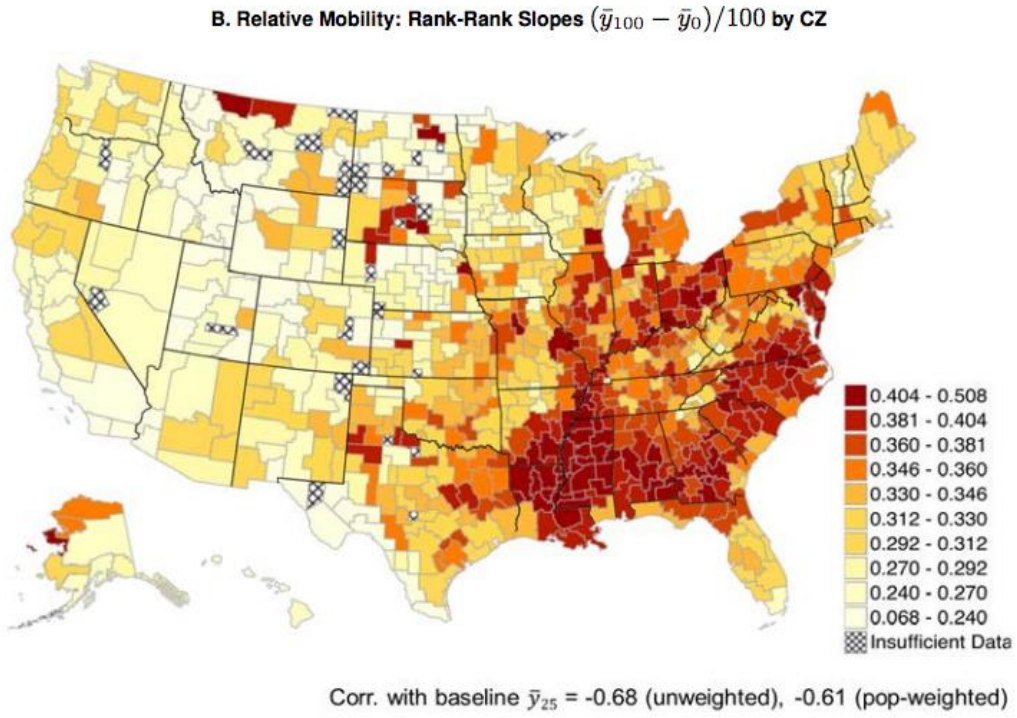
Illinois ranked lower than several smaller states such as Massachusetts, North Carolina, Washington, and Maryland. On a per capita basis, only Texas has a lower per capita economic impact of federal research than Illinois, and the state of Massachusetts has nearly five times the economic impact from all federal sources. (Table 3)

Table 3: Per Capita Impact of Federal Research Funding

State	Federal Research Impact (in billions)	Impact Population (in millions)	Dollars per Capita
Massachusetts	$3.90	6.7	$582.00
Maryland	$1.40	5.9	$237.28
Washington	$1.40	7	$200.00
Pennsylvania	$2.40	12.8	$187.50
New York	$3.30	19.6	$168.40
North Carolina	$1.60	9.9	$161.61
Ohio	$1.50	11.6	$129.30
California	$4.50	38.3	$117.50
Illinois	$1.36	12.9	$105.42
Texas	$1.90	26.5	$71.70

Finally, underscoring the close relationship between science and economic development, a recent landmark report, "The Geography of the American Dream", ranked all 50 states and metropolitan areas on economic opportunity as measured by the upward mobility of its residents. Although southern states and metropolitan areas ranked the lowest, the State of Illinois and traditional Rust Belt cities in the Midwest ranked below the Western United States and the Northeast relative to the ability for young people to move into higher income brackets. (Map 1)

Map 1: Relative Mobility



Researchers from Harvard University and UC Berkeley also ranked metropolitan regions according to "intergenerational upward mobility" to identify cities where children are able to move ahead and do better than their parents. Salt Lake City, Pittsburgh, San Jose, Boston and San Francisco, all places with significant bioscience economic development, were identified as "capitals of the land of opportunity." (Table 4)

Children living in Chicago in a family in the bottom fifth of national income have a 6.5 percent chance of moving to the top fifth, according to the study. Chicago was ranked 36 out of 50 markets in terms of intergenerational upward mobility. Tripp Umbach believes that transformational projects, such as the one contemplated by Carle

Health System and the University of Illinois at Urbana-Champaign, will serve to improve upward mobility in the State of Illinois as a whole.

Table 4: Metropolitan Regions Ranked by Intergenerational Upward Mobility

Rank	City
1	Salt Lake City
2	Pittsburgh
3	San Jose
4	Boston
5	San Francisco
6	San Diego
7	Manchester, NH
8	Minneapolis
36	Chicago

Key Finding #2: The new independent college of medicine has the opportunity to attract new federal funding into the state of Illinois.

Building on the first key finding, Tripp Umbach believes that a new independent college of medicine provides the University of Illinois as a whole, and specifically the Urbana-Champaign campus, with the opportunity to tap into a larger federal research funding pool. Tripp Umbach's review found that the University of Illinois at Urbana-Champaign campus is consistently among the top five university recipients of National Science Foundation (NSF) funding, but ranks in the middle (77th out of all recipients) for National Institutes of Health (NIH) funding.

Tripp Umbach reviewed the success of the University of Illinois at Urbana-Champaign in capturing NSF funding, as well as the amount of NIH funding that is currently going to other U.S. medical schools that have relationships within these grants with the Urbana-Campaign campus. Tripp Umbach assumes that if a new, independent, engineering and technology-based four-year college of medicine was located on the Urbana-Champaign campus, a significant increase in the percentage of total NIH funding would be realized by the University of Illinois, based upon the millions of dollars a month in NIH funding that is going to other college of medicine collaborators.

NIH funding to universities in Fiscal Year 2012 equaled $18.3 billion, of which the University of Illinois at Urbana-Champaign received less than one-half of one percent ($71 million). Within the much smaller NSF funding pool provided to universities, equaling $4.4 billion in 2012, the University of Illinois at Urbana-Champaign received a full 3 percent ($126 million).

NIH recently prioritized the need to change the way clinician scientists are educated by creating the National Center for Advancing Translational Sciences (NCATS) as the newest of its 27 Institutes and Centers. The NCATS was created to transform the translational science process so that new treatments and cures for disease can be delivered to patients faster. As students at the new independent college of medicine will be trained by active clinician-researchers working in engineering and basic and behavioral science departments, the opportunity to attract significant NCATS funding will exist from the onset of the new program. This model of medical education will teach students how to translate advances in technology and science into the clinical environment, precisely the transformation that the NIH is demanding.

Key Finding #3: Carle Health System and the University of Illinois at Urbana-Champaign must move quickly to capitalize on the benefit of this revolutionary college of medicine model.

Tripp Umbach's analysis of U.S. medical schools indicates that the recommended independent college of medicine will be among the first engineering and technology-based medical school. Such a unique program will be designed to take advantage of the revolutionary advances in engineering, technology, and quantitative sciences to further biomedical research and education. The recommended college of medicine model has the opportunity to tie innovations in technology to improvements in human health in a way that has never been done before by a new program. Therefore, the new program must be viewed from the start as much more than a medical education training program.

Tripp Umbach has identified the following benefits to both the Carle Health System and the University of Illinois as they move forward with plans to develop an independent medical school:

University of Illinois at Urbana-Champaign

A principal benefit of a new college of medicine program is that such a program can be focused on the challenges and realities of 21st century medicine, and not constrained by historical models of education, patient care, and research. The University of Illinois, through this new independent partnership program, must quickly establish itself as one of the leading players in what will become the future of academic medicine. While there have been many new medical schools established in the United States since 2005, only the partnership program in Virginia between Carillion Health System and Virginia Tech has a mission similar to the recommended model included in this report. The University of Texas at Austin, one of the institutions that the University of Illinois' Board of Trustees identifies as a "dashboard peer," has announced that the first class of its Dell Medical School will be accepted in 2016. Of top 50 NIH-funded medical schools, only Michigan, Stanford and Purdue are located

at universities that also have top 10 engineering programs. While all three of these institutions are currently organized around a traditional college of medicine program, all three are in transition to be positioned for the next generation of teaching, training, discovery, and healing to meet future needs. The new model of medical school will enhance opportunities for external funding.

The window for the University of Illinois at Urbana-Champaign will not remain open for long, as top-tier expertise in engineering, the key link in this transformation, can be purchased by all top-tier medical schools and hospital systems. Tripp Umbach believes that poorly performing colleges of medicine will have a difficult time attracting top engineering talent. The top 10 medical schools in the United States already have relationships with the University of Illinois at Urbana-Champaign. Therefore, it is important that the University of Illinois recognize the need to develop a program that has exceptionally strong integration between medicine and advanced science, as there are multiple examples nationally where proximate universities have strong partnerships[1].

Carle Health System

Tripp Umbach cautions that the window of opportunity for partnership between the Carle Health System and the University of Illinois at Urbana-Champaign is exceptionally time-limited. The Mayo Clinic and the Cleveland Clinic have strategies in place to maintain leadership positions in research-driven personalized medicine. While Mayo and Cleveland do not have a world-class engineering school within their institutions, they have already overcome this deficiency by partnering with strong engineering programs. For example, in the case of Mayo Clinic, they have partnered with the University of Illinois at Urbana-Campaign (www.mayoillinois.org). The Mayo Clinic has also partnered with the University of Minnesota for nearly 15 years through the Minnesota Biotechnology Partnership, and the Cleveland Clinic has a similar relationship with Case Western Reserve University. It must also be noted that other emerging health systems throughout the United States, such as Greenville Health System, Lehigh Valley Health Network, INOVA, and Geisinger Health System, are developing similar college of medicine partnerships to achieve national prominence in personalized medicine.

While the new Dell Medical School in Austin is anticipated to have a strong focus on computational science, the proposed college of medicine outlined in this report will pair engineering, technology, and computational science with Carle Health System's fully integrated health care delivery system. Tripp Umbach believes that the

[1] Notable partnerships between medical schools and universities include: Harvard University and Massachusetts Institute of Technology, University of Pittsburgh and Carnegie Mellon University, and Emory University and Georgia Tech.

Carle Health System must capitalize immediately on the opportunity to partner with the University of Illinois to develop technology, engineering, and computation solutions to meet the demands of a new paradigm of health care delivery. Since governmental units at all levels, employers, payors, and patients are demanding outcomes-based medicine and health care delivery which incorporates behavioral influence on patient wellness through technology, the Carle Health System and the University of Illinois will have exceptional support for this program locally, regionally, statewide, and nationally.

Key Finding #4: A separately accredited, independent college of medicine with an innovative curriculum is critical to ensure the long-term viability of the new medical school.

An important consideration in Tripp Umbach's recommendation for a highly specialized independent college of medicine with a class size appropriate for a fully integrated health system is the need for a revolutionary curriculum where all teachers, learners, trainees, researchers, scientists, and innovators (entrepreneurs) are under the institutional infrastructure. Therefore, the development of an innovative curriculum which responds to the changes that have occurred in health care over the past decade and also addresses established and ever-changing LCME requirements will be challenging in the short term, but vital to the success of medical education in the long term. As referenced in Section V, Consideration of Other Options, Tripp Umbach does not believe that developing a LCME-approved "track" of the existing state-supported UIC College of Medicine program can effectively accomplish what a separately accredited program could achieve, especially as the new program will have a high degree of integration with science and technology programs in Urbana-Champaign.

Tripp Umbach recommends that the University of Illinois at Urbana-Champaign continue to gather curriculum input from key stakeholders throughout the region, state, and nation as the development of the new school continues. The traditional college of medicine curriculum educates physicians through an outdated approach for addressing disease progression and symptoms (examination, diagnostics, and treatment) and emphasizes memorization versus self-directed discovery. The new school's curriculum must be rooted in the convergence of medicine and engineering, computer sciences, quantitative sciences, and technology to teach the human body as an integrated system. This understanding of the human body as an integrated system is critical to the analytical, problem-solving skills needed to be a successful physician. Engineering technologies and approaches should be incorporated throughout the curriculum. Examples include:

- In microbiology, the curriculum can provide an understanding of microbes and engineering approaches to the alteration of genomes and biological circuits.

- In clinical training, the curriculum can incorporate bioreactor use, 3D printing, and advanced analysis techniques.
- In computer sciences, the curriculum can include data mining techniques to create patient care guidelines.
- Student experiences can include interactions not only with physicians and patients, but also with engineers and new innovations for advancing medical care.

The curriculum will have immediate societal and economic impacts as students at the new independent college of medicine gain an understanding of how to influence behavioral change relative to the use of technologies such as wearable sensors to address issues such as obesity. The new curriculum will teach students how to use tools, such as electronic health records and wearable technology, to track patient behavior and outcomes, including cost of care. Students will also learn to work in team environments with other clinicians, such as physician assistants and nurses, so that health care can be delivered by the right provider in the right setting.

The unique nature of a partnership between the Carle Health System and the University of Illinois at Urbana-Champaign will allow the new independent college of medicine to impact outcomes in a way that organizations without an integrated delivery and financing system cannot. This integrated system will provide all of the components necessary to address the changes in health care delivery required by technology advances, patient-driven care, and the Affordable Care Act, and these components will allow the new independent college of medicine to transform medical care from volume-driven to value-driven care. The Urbana-Champaign community can serve as a pilot for the rest of the country by training physicians to provide the most appropriate care in the most appropriate setting.

Physicians who graduate from the new independent college of medicine will be trained to incorporate analytical techniques and innovations into a human systems approach to delivering health care. It is recommended that the curriculum allow physicians to:

- Practice problem-solving and analytical thinking critical to understanding disease etiology and developing a new foundation for health management.
- Leverage computational science, analytics, and personalized therapeutics.
- Be experts in the use of data synthesis techniques and new technologies.
- Adopt and develop innovations through collaboration with interdisciplinary teams comprised of bioscientists, engineers, and clinicians. Despite the growth in inter-professional training in

recent years, the vast majority of health professionals are never exposed to collaborative care until they enter the workforce. The result is that hospitals, clinics, and other practice sites have to retrain individuals to work in teams. Tripp Umbach believes inter-professional education takes significant commitment from all levels of academic leadership in medical, nursing, and other health professional schools to make it successful. Tripp Umbach acknowledges that the recommendation to develop a medical and science education and research campus will not be without logistical challenges as schools have different calendars, and different professions take varying approaches to teaching the same material. However, the goal is to improve the health of the public by preparing professionals to work in more effective ways. Studies have shown that inter-disciplinary collaboration has the capacity to impact both health care providers and patients. The Joint Commission currently reports that almost 70 percent of patient adverse events are related to the lack of collaboration and communication between providers. Interdisciplinary collaboration plays an important role in the elimination of errors and duplications in care, and in the clarification of roles. When collaboration takes place among nurses, physicians, and patients, each person understands the goals and the processes through which to attain the goals. Avoidable re-hospitalizations are frequent, costly, burdensome for patients and families, and fortunately, actionable for improvement. Many re-hospitalizations within 30 days of discharge are considered potentially avoidable if communication was more effective and care better coordinated. Accreditation agencies such as the Joint Commission have now put collaboration practice guidelines into place for health care organizations, and are requiring their implementation for accreditation.

- Understand the capabilities of virtual learning environments and computational modeling and analytics. Graduates will leverage these in designing the "ICU of the future" and the "Operating Room of the future", evaluating new medical delivery systems, and delivering care to patients in remote locations.

Key Finding #5: Building on the existing economic impact of the University of Illinois and the Carle Health System, the new independent college of medicine will have substantial economic impact on the region and state of Illinois.

Medical education is a major driver of the U.S. economy, as medical schools and teaching hospitals generated nearly $600 billion in economic impacts, supported more than 3.3 million jobs, and generated $22 billion in state

government revenue in 2012[2]. As outlined earlier in this report, the academic medical industry in Illinois generated more than $28.7 billion in the state's economy in 2012, and supported more than 155,000 jobs directly and indirectly.

Expanding medical education through the model outlined above represents an important step in the economic development in Northeast Illinois, the Chicago region, the state of Illinois, and neighboring states. The project sponsors, the Carle Health System and the University of Illinois at Urbana-Campaign, already provide a significant source of economic, employment, and government revenue impact to the region and to the state of Illinois. Tripp Umbach estimates, based on national standards for hospitals and universities, that the Carle Health System and the University of Illinois at Urbana-Champaign add more than $3 billion to the regional economy annually and support more than 20,000 jobs directly and indirectly in the region[3].

It is also important to recognize in this feasibility study that UIC College of Medicine and University of Illinois Hospital in Chicago are important economic engines for the city of Chicago and the state of Illinois.

In 2012, according to the AAMC, the total economic impact of UIC College of Medicine was $1.48 billion. AAMC data indicates that the UIC College of Medicine supported 8,682 jobs statewide. The following data illustrates the economic impact of UIC College of Medicine and Medical Center in Chicago in 2012. (Table 5)

Table 5: Total Economic Impact[4]

Entity	Economic Impact (2012)	Employment Impact (2012)
UIC College of Medicine	$1.48 billion	8,682
University of Illinois Medical Center	$1.22 billion	5,044
Total	$2.7 billion	13,728

[2] Association of American Medical Colleges, "The Economic Impact of Medical Schools and Teaching Hospitals, 2012.

[3] Tripp Umbach estimates that total employment on the University of Illinois at Urbana-Campaign campus and Carle Foundation Hospital equals approximately 13,500 full or part-time jobs.

[4] Source: Association of American Medical Colleges, 2012.

Impacts Associated with the New College of Medicine

Tripp Umbach estimates that the total economic impact of the new college of medicine enterprise will exceed $1 billion annually by 2035 when the school is at full maturity. The new school is expected to sustain more than 7,600 jobs statewide by 2035. This impact will stem from the spending by the medical school, the Carle Health System, and related research institutes on capital improvements, goods and services, the spending of staff and faculty, the spending of medical trainees, and the spending (external to the institution) of visitors to the proposed school. This impact is conservative in its projected spending related to capital expenditures needed to operate a medical school, such as equipment, clinical supplies, and non-salary related expenditures for the medical school.

The economic benefits generated by the development of a new research-intensive college of medicine extend beyond the direct impact of its operations. The number of benefits generated in the region as a result of the college of medicine will include newly constructed neighborhoods and schools to support the anticipated increase in families relocating to the region, and communities championing the expansion of dedicated education, greater choices for entertainment, and improved transportation from Urbana-Champaign to Chicago, the east and west coasts. In addition to the construction of new homes and schools to support projected population increases, the need for new retail, banking, and commercial opportunities will serve as additional economic benefits for the region.

The proposed project will enhance the economic environment of the Urbana-Champaign metropolitan area because the quality of health care resources has a favorable impact upon the decisions made by business owners who are looking to locate or relocate companies. An economic impact analysis completed by Tripp Umbach for the Association of American Medical Colleges (AAMC) shows that states with strong medical schools and teaching hospitals stimulate research and biomedical industry business development outside of the medical college. Economic impact studies completed by Tripp Umbach for the AAMC since 1995 show a direct correlation between the presence of medical schools and a growing economy. Data presented in other sections of this report show that states with research-intensive medical schools have the strongest economies on a per capita basis. The new research-intensive college of medicine will be attractive to medical-related companies who are likely to establish a greater focus within the area, seeking the competitive advantage of proximity to a major academic medical center.

Tripp Umbach agrees with the conclusions of a recent Business Development Cluster report indicating that a new college of medicine at the University of Illinois at Urbana-Champaign campus would accelerate economic development and job creation in Central Illinois and the state as a whole through the emergence of a vibrant

biomedical and bioengineering business cluster. Although the college of medicine will be designed to graduate a relatively small number of physicians each year, graduates will make significant impacts in the development of medical innovations. It is important to point out that many of the graduates will move to other cities, including Chicago, where job opportunities exist and where quality of life options are varied and numerous. Because of their unique knowledge base, they will impact organizations in Chicago, all of Illinois, and the entire nation, bringing recognition for the state of Illinois' leadership in innovation. The proposed new college of medicine will have multiple economic and social benefits as it leverages revolutionary advances in engineering, technology, and quantitative sciences to further biomedical research and education.

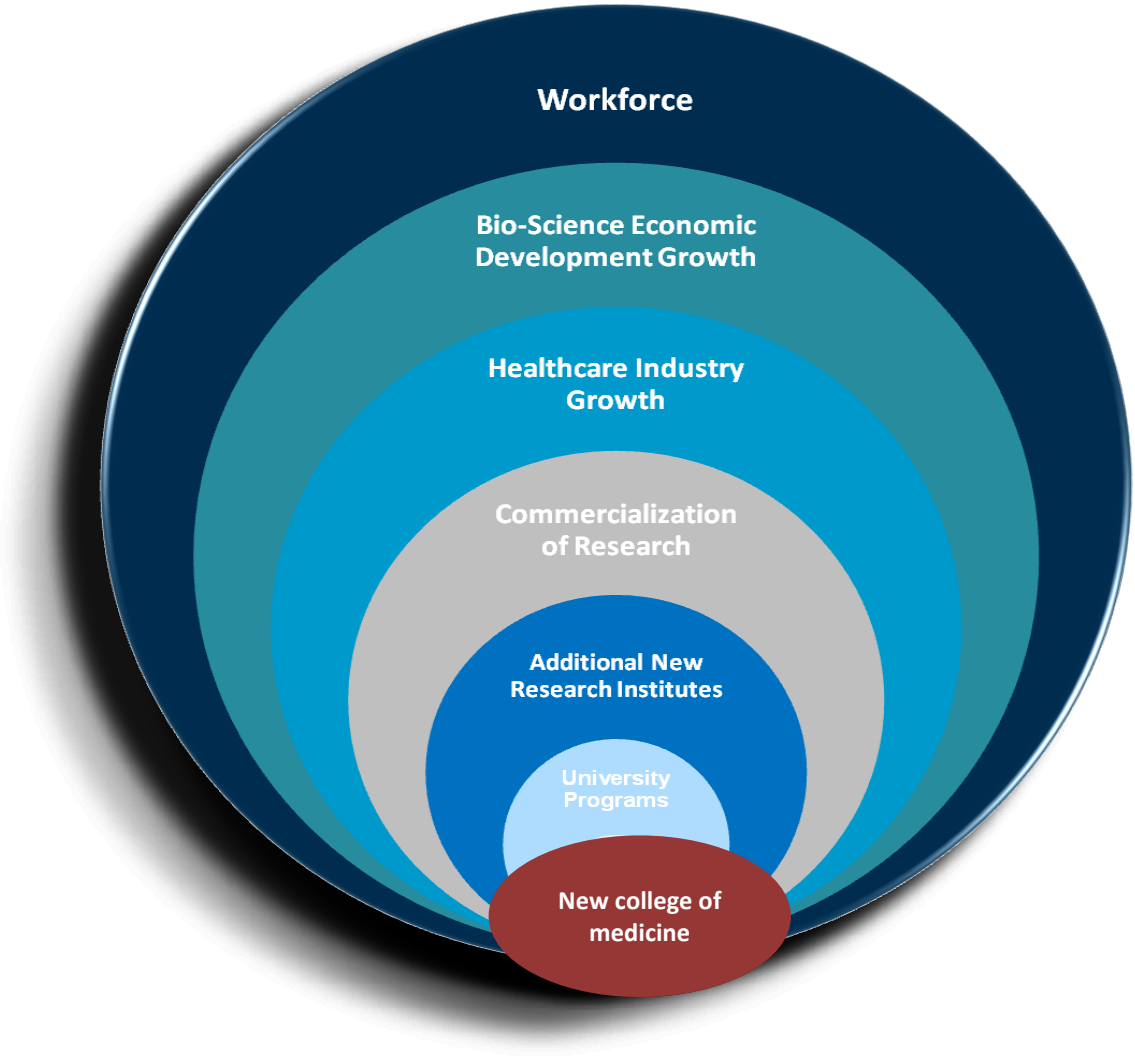
The convergence of medicine and engineering in Urbana-Champaign is already resulting in significant startup company formation, and this type of activity will be enhanced through the presence of additional physician scientists, research integration with clinical sites, and increased clinical trials. Examples of startup companies formed in the last five years by faculty from the University of Illinois at Urbana-Champaign are included in Table 6, and details for these and additional companies launched in this time period can be found in Appendix B. Many of these companies have already secured significant venture capital and are collaborating with a number of medical institutions, including Carle, to conduct clinical trials. (Table 6)

Table 6: Examples of Startup Companies Formed by Faculty in Past Five Years

Company	Core Technology	Origin	Additional Notes
Diagnostic Photonics	Tissue Microfracture Imaging	Electrical & Computer Engineering	Clinical trials completed at Carle & John Hopkins
MC10	Wearable systems, home diagnostics, remote monitoring	Material Science and Engineering	Major venture capital backing
Daktari	CD4 counting technology of point-of-care tools	Bioengineering	Major venture capital backing
Metabolomx	Colorimetric sensor array for detection of lung cancer from breadth	Chemistry and the Beckman Institute	Has partnered with Cleveland Clinic
Paxent LLC	Data analytics	Computer Science	Has partnered with Carle
Vitruvian Biotech	Image-guided nanoparticle drug delivery	Bioengineering	Initial research completed at the Carle Biomedical Research Center

The proposed development of the new college of medicine represents a "rock hitting the pond" (see Image 2 below) as it creates significant additional economic and social benefits for the Urbana-Champaign region, Chicagoland, and the state of Illinois over the next 20 years. (Image 2)

Image 2: Multiple Impacts of the Campus



The new college of medicine and its partnerships with the Carle Hospital Foundation, the University of Illinois, and other regional health care organizations, private businesses, and research-related organizations are the springboard for future economic development in Urbana-Champaign and throughout the state of Illinois. These partnerships have the opportunity to launch new industries and add value to existing industries, creating new high-paying jobs in health care, higher education, and related industries.

Detailed Economic Impact Findings:

Additional impacts created by the construction and operations of the recommended new medical education research enterprise will further stimulate the economic growth of the region via increased economic activity, as well as the unique impacts of an expanded medical college, such as increased research activities and funding from sources outside the region. Tripp Umbach estimates that the impact of the recommended college of medicine option has the potential to grow from $39 million annually, the current level of impact, to more than $1 billion in annual economic impact when the program is at full maturity in 2035. (Table 7)

Table 7: Economic Impact of the New College of Medicine (in millions)

Category of Impact	Existing COM at Urbana campus (2014)	New COM - 2021 (after start-up)	2030	2035 (Maturity)
College of Medicine Program Impacts	$26.4	$83.2	$210.5	$390
*Research Program Impacts (included in College of Medicine Program Impacts Listed Above)**	*$1.8 ($1 million in expenditures)*	*$28.4 ($15 million in expenditures)*	*$162 ($90 million in expenditures)*	*$270 ($150 million in expenditures)*
Clinical Program Impacts	$5.3	$16.8	$60.5	$120
Commercialization Impacts**	$7.3	$60	$480	$900
Total Economic Impact*	**$39.0**	**$160.4**	**$750.5**	**$1.4 billion**

*Research Program Impacts are included in College of Medicine Program Impact Totals.
**Commercial impacts include direct, indirect, and induced jobs from the college of medicine as well as bioscience industry cluster growth.
***Impacts do not include the significant economic and employment impacts that will result from the construction of facilities related to the new college of medicine.

In addition to the business volume impact the proposed college of medicine and research campus is expected to generate, the proposed campus will also create a substantial number of jobs throughout the region. The employment impact of the proposed campus will also be comprised of direct and indirect impacts. Direct employment impact represents full-time equivalent positions created directly by the proposed college. The positions included in the direct employment for this analysis include the faculty, support staff, and residents who will be employed in the region specifically due to the development and operation of the regional college of

medicine campus. Indirect employment impact represents full-time equivalent positions created as a result of the proposed college's spending and the spending of faculty, staff, students, and visitors.[5]

While the current University of Illinois Chicago College of Medicine at Urbana campus supports approximately 215 jobs in the region, the new college of medicine is expected to increase employment in the region dramatically over the next 20 years. The employment impact of the proposed enterprise will be over 5,600 jobs by 2035 when the program is at full maturity. (Table 8)

Table 8: Employment Impact of the New College of Medicine (total Jobs created directly and indirectly in the state's economy)

Category of Impact	Existing COM at Urbana campus (2014)	New COM 2021 (after start-up)	2030	2035 (Maturity)
College of Medicine Program Impacts	145	460	1,290	2,167
Research Program Impacts (included in College of Medicine Program Impacts Listed Above)	*10*	*160*	*900*	*1,500*
Clinical Program Impacts	30	95	340	690
Commercialization Impacts**	40	335	2,750	5,000
Total Economic Impact*	**205**	**795**	**3,480**	**7,857**

*Research Program Impacts are included in College of Medicine Program Impact Totals.
** Commercial impacts include direct, indirect, and induced jobs from the college of medicine as well as bioscience industry cluster growth.
***Impacts do not include the significant economic and employment impacts that will result from the construction of facilities related to the new college of medicine.

Tripp Umbach believes that the economic impact of the new college of medicine presented below will add to the current economic impact of the Chicago-based hospital and University of Illinois Chicago College of Medicine in Chicago. Furthermore, Tripp Umbach projects that the economic impact of the University of Illinois Chicago College of Medicine and hospital in Chicago will grow over the next several years. (Table 9)

[5] Examples of indirect jobs created in support of the proposed college of medicine include teachers at schools attended by the children of employees, affiliated researchers, and financial service professionals.

Table 9: Total Projected Economic Impact of UIC College of Medicine and the New College of Medicine (2021 and 2035)

Entity	Economic Impact (2012)	Economic Impact (2021)	Economic Impact (2035)
UIC College of Medicine	$1.48 billion[6]	$1.78 billion[7]	$2.34 billion[8]
University of Illinois Medical Center	$1.22 billion	$1.47 billion	$1.92 billion
New College of Medicine		$160 million	$1.4 billion
Total	$2.7 billion	$3.3 billion	$5.6 billion

Social Impacts related to the recommended program:

At a time when severe physician shortages have been predicted and the Affordable Care Act is increasing health care access to over 30 million citizens, it is imperative to improve the health care delivery system and develop a means to provide services at lower costs. States across the U.S. are evaluating their health care systems and the opportunity for new education, which has led to the development of 15 new medical schools since 2006, after none had opened in the previous two decades. Our proposed recommendations present an opportunity for the state of Illinois to be at the forefront of the health care industry for the 21st Century by:

- Reinventing health care around revolutionary advances in engineering and technology to further biomedical research, biomedical practices, and education, and therefore modernizing the education of physicians from wellness through treatment with an integrated system which transforms and improves outcomes of care while expanding the economy.

[6] Includes impact of the Urbana campus.
[7] Based on 2 percent growth rate for the UI College of Medicine over the period.
[8] Based on 2 percent growth rate for the UI College of Medicine over the period.

V. CONSIDERATION OF OTHER OPTIONS

Tripp Umbach conducted interviews with leaders representing higher education, health care, industry, and government over an intensive two-month period to develop and test various medical school development models. The recommended model, outlined in greater detail in the first section of this report, calls for the development of a specialized engineering-based college of medicine in Urbana-Champaign through a corporate structure created by the Carle Health System and the University of Illinois at Urbana-Champaign.

Two other models analyzed within the feasibility study are presented below, including 1) developing a new college of medicine through stronger alignment with UIC College of Medicine, specifically expanding the current Urbana-Champaign campus to capitalize on the opportunities outlined in other sections of this feasibility study – health care and economic transformation, and 2) developing a larger regional college of medicine with partner hospital systems in both Urbana-Champaign and Peoria (1-74 Corridor Program).

Campus Expansion of University of Illinois College of Medicine at Urbana-Champaign Regional Campus:

Under this option, the University of Illinois at Urbana-Champaign would not pursue a separately accredited college of medicine in Urbana-Champaign, nor enter into a partnership with the Carle Health System, but would continue to host the University of Illinois Chicago College of Medicine regional campus on the Urbana-Champaign campus and work with that entity to make this campus more aligned with the needs and strengths of the Urbana-Champaign campus.

Tripp Umbach acknowledges the following advantages and challenges associated with this option:

- **State Support** – This model ensures that UIC College of Medicine remains the largest allopathic college of medicine in the U.S. and continues its mission of training physicians statewide. However, being a large college of medicine is not a goal shared equally among campuses, as the size of the student body is less important in a science and technology-focused program. Also, since 2005, there has been a 34 percent increase in the number of medical students educated in the United States and only a 2 percent growth in training sites for graduate medical education. The challenge in 2014 and beyond will be the development of more residency positions--not more medical students. Tripp Umbach's recommended model does include the provision that 125 first-year students continue to receive their education at the Urbana-Champaign campus.

 Statewide college of medicine models with multiple regional campuses are not as critical today as in the past when most patients were taken to big cities for care. There are very limited clinical or educational

benefits of a network of college of medicine campuses when 95 percent of all care in the region can be supported by a hospital such as the Carle Hospital Foundation. The old model of needing a college of medicine and an associated large specialized urban teaching hospital to support education and clinical care is not a reality in 2014. The care that the Carle Health System cannot provide is transferred to top health care centers regionally, such as Mayo Rochester, Washington University in St. Louis, and Northwestern in Chicago.

- **Culture** – While acknowledging the difficulty to retrofit a 19th/20th century medical education model and training program into such a unique research and technology model geared for the 21st century, Tripp Umbach believes that having a single "floating" college of medicine that can be claimed by both campuses as "their" college of medicine has merits. Such a model, with a dual-reporting structure to Chicago and Urbana-Champaign and a Dean's office in both locations, is more desirable than a model to expand the four-year college of medicine out of the University of Illinois at Urbana-Champaign College of Medicine within the current structure, where the Chicago campus has control of regional campuses. However, changes would be required in areas ranging from accreditation, institutional culture, and significantly increasing state support for public medical education.

 UIC College of Medicine has one of the lowest per-pupil NIH funding of any college of medicine in the country, and as such will have difficulty aligning with the University of Illinois at Urbana-Champaign, which seeks to have a heavily research-focused program with a small class size and one of the highest research per-pupil populations in the country.

 Tripp Umbach also questions the ability to generate needed philanthropic support in the Urbana-Champaign region for what will be perceived as a Chicago-based college of medicine due to the significant distance and differences in key donor populations between the two regions.

 Finally, Tripp Umbach questions how a "common campus" college of medicine model could be sustainable, when years of little or no collaboration suggest that UIC College of Medicine leadership will not embrace a new focus for the Urbana-Champaign campus that builds on the strengths of the University of Illinois at Urbana-Champaign. More importantly, the flow of funds between campuses and executive decision-making functions (requirements of the LCME) do not suggest to Tripp Umbach a single college of medicine will be able to fulfill two substantially different missions with excellence and national leadership. We do believe that both the Chicago and Urbana-Champaign campuses can achieve national leadership through two separately focused colleges of medicine.

- **Ensuring Two Strong Colleges of Medicine** – Tripp Umbach believes that a new engineering-focused college of medicine at the Urbana-Champaign campus through an independent partnership with the Carle Health System will result in more funding opportunities for new capital investment in Chicago in areas of drug discovery, disparities/population health management, and biotech economic development. UIC College of Medicine already trains the most diversified body of future practitioners in the nation. It now has the opportunity to establish itself as the national leader in addressing diversity in the health care industry and focus on addressing urban health care services, including alignment with the Illinois Medical District (IMD) strategic plan that specifically sets out clinical trials leveraging the diverse patient population of the IMD.

 Tripp Umbach concludes that expansion of the University of Illinois at Urbana-Champaign College of Medicine, as discussed above, is more costly to the state of Illinois than a new independent college of medicine organized as a private non-for-profit corporation. Expanding the Urbana campus through the current state-supported medical education model will cost taxpayers in initial capital and ongoing operational support, while at the same time limiting the amount of new research funding in core areas such as Engineering, Biotechnology, and Computational Science that is likely to flow into a new medical college.

Independent State-Supported New College of Medicine with Campuses in Urbana-Champaign and Peoria:

Tripp Umbach evaluated the option for the University of Illinois to develop a separately accredited public four-year college of medicine with a larger class size (150+ students per class) with educational and clinical campuses in both Urbana-Champaign and Peoria, involving multiple health systems as affiliates.

Tripp Umbach acknowledges the following advantages and challenges associated with this option:

- **Capacity** – Tripp Umbach's financial analysis found that a regional college of medicine with larger class size would enable a new college of medicine to have greater immediate, but not necessarily long term financial stability. However, this model assumes that the new college would have a medical education/physician workforce focus, with less resources being directed to research. Peoria, a larger regionally-based health system and more fully developed college of medicine infrastructure, has the opportunity with Carle Health System and other systems to become a national leader in medical education, remote health care delivery, simulation, and population health management – due to the larger scale with more than 1.5 million residents along the I-74 corridor. Tripp Umbach believes that a

regional delivery system with partnership campuses in Peoria and Urbana-Champaign has the opportunity to integrate new medical training that focuses on population health management and remote care with telepresence and other technologies such as bioinformatics and biomarkers that impact care delivery.

- **Mission and Cultural Alignment** – Tripp Umbach acknowledges the strengths that a newly formed regional college of medicine could bring to the region and its institutions. However, findings from interviews suggest that the distance between Peoria and Urbana-Champaign would provide challenges for collaboration. Additionally, the most significant concern expressed by stakeholders is the negative financial and educational impact that such a model would present to the University of Illinois at Chicago College of Medicine.
- **Regional Economic Development** – While collaborative opportunities with hospitals and medical centers in Peoria, Urbana-Champaign, and Danville open up the possibility of an I-74 Medical Innovation Corridor, Tripp Umbach believes that regional economic development partnerships can occur within the context of the recommended independent new medical college.
- **Timing** – Due to the complexity of multiple state institutions, the development of such a model would require several additional years of planning, which would compromise the potential economic impact. Partnering with a community health care organization maximizes the flexibility of the program and allows for expedient decision making. The years of additional planning could also result in foregoing the immediate uniqueness and competitive advantage that will be secured if Carle Health System and the University of Illinois at Urbana-Champaign moved quickly as recommended by Tripp Umbach.

VI. CONCLUSIONS

Tripp Umbach believes that sufficient human and financial resources can be developed over the next three years to ensure the successful launch of a specialized college of medicine through an equal partnership with the Carle Health System and the University of Illinois at Urbana-Champaign. Ideally, the new college of medicine will enroll students by the fall of 2017, and become fully operational with all classes and programs by 2021.

Tripp Umbach developed this conclusion based upon the following factors:

1. ***Independent Program with Strong Partners:*** An independent private structure builds upon the strengths of two strong organizations without taking funding away from an established state-supported medical college. The Carle Health System's structure, as a financially strong, fully integrated health system with a teaching hospital, outpatient clinics, and an insurance company, as well as high quality of care scores, provides a strong foundation upon which to build a successful independent medical college. As the only fully integrated health care system in Illinois, the Carle Health System has the integrated medical records system and data analytics capability to improve health outcomes of individual patients and larger patient populations. It is important to highlight the need to develop and maintain strong partnerships between Carle Health System and the University of Illinois at Urbana-Champaign, a key factor to success. The University of Illinois at Urbana-Champaign is consistently among the top five universities in National Science Foundation (NSF) funding, and a new engineering-focused college of medicine based in Urbana-Champaign will immediately be positioned to bring new federal dollars into the region and the state of Illinois for innovative multidisciplinary research integrating patients, scientific research, and advanced technology-driven programs on the University of Illinois Urbana-Champaign campus.

2. ***Opportunity for Federal Funding*:** Tripp Umbach reviewed the success of the University of Illinois at Urbana-Champaign in capturing National Science Foundation (NSF) funding, as well as the amount of National Institutes of Health (NIH) funding that is currently going to other U.S. medical schools that have relationships within these grants with the Urbana-Campaign campus. Based upon the millions of dollars of NIH funding that are provided each month to medical schools that have collaborations with the University of Illinois at Urbana-Champaign, Tripp Umbach assumes that if a new independent engineering and technology-based four-year college of medicine were located on the Urbana-Champaign campus, a significant increase in the percentage of total NIH funding would be realized by the University of Illinois. As students at the new independent college of medicine will be trained by

active clinician-researchers working in engineering and basic and behavioral science departments, the opportunity to attract significant National Center for Advancing Translational Sciences (NCATS) funding will exist from the onset of the new program. This model of medical education will teach students how to translate advances in technology and science into the clinical environment, precisely the transformation that the NIH is demanding.

3. ***Revolutionary Curriculum*:** The new college will be among the first nationally to differentiate itself through the fully integrated development of a revolutionary curriculum based upon collaboration between medicine, engineering, technology, and quantitative sciences. This differentiation provides the college with an immediate competitive advantage over existing national and international medical schools. Tripp Umbach believes that a smaller, highly specialized medical college, developed through a private-public partnership between the University of Illinois at Urbana-Champaign and the Carle Health System, is preferable to a traditional clinically-focused multi-hospital distributed training model which is better suited to meet physician workforce needs. The development of an innovative curriculum which prepares physicians to deliver appropriate care in an inter-professional, patient-centered environment along with ready access to the next generation of sensors, materials, imaging, and robotics will produce physician scientist leaders who will train other community-based physicians who graduate from the University of Illinois and other medical schools throughout the United States and internationally.

4. ***Economic Impact Growth Statewide*:** The new college of medicine and its multiple partnerships with the Carle Health System, the University of Illinois, and other regional health care organizations, private businesses, and research-related organizations, is the springboard for future economic development in Urbana-Champaign and throughout the state of Illinois. These partnerships have the opportunity to launch new industries and add value to existing industries, creating new high-paying jobs in health care, higher education, and related industries. Tripp Umbach believes that the economic impact of the new college of medicine will add to the current economic impact of the University's Chicago-based hospital and medical college. Furthermore, Tripp Umbach projects that the economic impact of the Chicago-based College of Medicine and hospital will grow over the next several years through partnerships with the new medical college, resulting in the combined economic impact of all entities growing from $2.7 billion currently to $5.6 billion in 2035.

5. ***The new college of medicine will strengthen the UIC College of Medicine*:** The Chicago-based public college of medicine will be supported and strengthened as it advances its important mission during the development of the new independent private medical college. A key element to strengthening the

current UIC College of Medicine is to engage the University's Vice Chancellor for Health Affairs and Dean of Medicine on the Board of Directors for the new medical college. This will ensure maximum collaboration, especially important as a collaborative approach has the most potential to increase NIH funding for the University Illinois. Tripp Umbach believes that by not requesting state General Revenue Funds support for the new college of medicine, more financial support will be provided for UIC College of Medicine to take advantage of the emerging revolution in medicine, driven in large part by engineering innovations. This revolution is already transforming the ability to deliver medicine and develop health protocols targeting specific populations.

APPENDIX A: INTERVIEWEE LIST

Tripp Umbach completed in-depth interviews with community leaders in health care, higher education, industry, government, and economic development organizations. The following table provides a listing of the organizations and the title of the individuals that were engaged. The next table lists the individuals in alphabetical order by last name. Interviews with business leaders and health care leaders are an important part of the feasibility study process, as strong community support is essential in assessing a project of this magnitude.

Table A. Titles of individuals grouped by organization.

Organization	Title
Carle Health System	CEO
	EVP and Chief Medical Officer
	VP of Research and Medical Education
	Executive Director, Research Institute
	Surgery/Surgical Oncology Carle Foundation Hospital, Founder Oracle Bioscience
	Surgical Oncologist, Biomedical Research Center
	Medical Director, Diagnostic Services and Strategic Development
	Senior Vice President, System Strategic Development
	Business Development
Horizon Hobby	Chairman of the Board
Illinois Innovation Council	Member
Illinois Medical District Commission	Executive Director
	President and Director of Strategic Engagement
Immuven	CEO
Jump Trading Simulation & Education Center	Chief Medical Officer
Naurex	President and CEO
Northwestern Feinberg School of Medicine	Assistant Professor of Medicine and Associate Director of the Medical Informatics Program,
OSF Healthcare	Chief Medical Officer for Simulation
Serra Ventures, LLC	CEO

Organization	Title
University of Illinois	Interim Vice President for Health Affairs
	President
University of Illinois Foundation	Vice Chancellor for Institutional Advancement and Senior Vice President
University of Illinois at Urbana-Champaign	Chancellor
	Associate Chancellor for Public Affairs
	Associate Chancellor for Corporate and International Relations
	Associate Vice Chancellor for Institutional Advancement
	Director of Strategic Communications, Office of Public Affairs
	Vice Chancellor for Academic Affairs and Provost
	Associate Chancellor & Vice Provost, Budgets and Resource Planning
	Associate Vice Chancellor for Research, Interim Director of the Division of Biomedical Sciences
	Director, Research Park
	Associate Provost for Strategic Planning and Assessment
	Former Associate Dean of Clinical Affairs
	Associate Director for Research, Coordinated Science Laboratory
	Vice Chancellor for Research
	Associate Chancellor
University of Illinois College of Medicine	Dean, College of Medicine
University of Illinois College of Medicine at Peoria	Regional Dean, College of Medicine

Organization	Title
University of Illinois College of Medicine at Urbana-Champaign	Associate Dean for Research
	Professor and Director, Medical Scholars Program
	Associate Dean of Student Affairs & Medical Scholars Program
	Associate Dean for Clinical Affairs and G/CME
University of Illinois Hospital and Health Sciences System	CEO
	Associate Vice President for Population Health and Professor of Medicine and Public Health

Table B. Individuals engaged listed in alphabetical order by last name.

Interviewees	Organization
Ilesanmi Adesida, PhD	Vice Chancellor for Academic Affairs and Provost University of Illinois at Urbana-Champaign
Michael Andrechak	Associate Chancellor & Vice Provost, Budgets and Resource Planning, University of Illinois at Urbana-Champaign
Dimitri T. Azar, MD	Dean College of Medicine University of Illinois College of Medicine
Joseph Barkmeier, MD	Medical Director, Diagnostic Services & Strategic Development Carle Foundation Hospital
Jerry Bauman, PhD	Interim Vice President for Health Affairs University of Illinois
Bryan Becker, MD	CEO University of Illinois Hospital and Health Sciences System
Stephanie Beever	Senior Vice President, System Strategic Development
Rohit Bhargava, PhD	Professor Beckman Institute for Advanced Science and Technology
Stephen Boppart, MD, PhD	Professor Beckman Institute for Advanced Science and Technology
Mike DeLorenzo, PhD	Associate Chancellor University of Illinois at Urbana-Champaign

Interviewees	Organization
James Dougherty, MD	Vice President of Research and Medical Education Carle Foundation Hospital
Bob Easter, PhD	President University of Illinois
Jennifer Eardley, PhD	Associate Vice Chancellor for Research, Interim Director of the Division of Biomedical Sciences University of Illinois at Urbana-Champaign
Laura Frerichs	Director, Research Park University of Illinois at Urbana-Champaign
Matt Gibb, MD	EVP and Chief Medical Officer, Carle Physician Group
James Hall	Associate Dean for Student Affairs & Medical Scholars Program University of Illinois College of Medicine at Urbana-Champaign
Chris Harris	Director of Strategic Communications, Office of Public Affairs University of Illinois at Urbana Champaign
Tim Hoerr	CEO Serra Ventures, LLC
Robin Kaler	Associate Chancellor for Public Affairs University of Illinois at Urbana Champaign
Anna Keck, MD	Executive Director, Research Institute Carle Foundation Hospital
Pradeep Khanna	Associate Chancellor for Corporate and International Relations University of Illinois at Urbana Champaign
Abel Kho, MD	Assistant Professor of Medicine and Associate Director of the Medical Informatics Program, Northwestern Feinberg School of Medicine
David Krantz PhD	Professor Biochemistry CEO Immuven
Jerry A. Krishnan, MD, PhD	Associate Vice President for Population Health and Professor of Medicine and Public Health University of Illinois Hospital and Health Sciences System
Stig Lanesskog	Associate Provost for Strategic Planning and Assessment University of Illinois at Urbana-Champaign
James Leonard, MD	CEO Carle Foundation Hospital
William Marshall	Associate Dean for Clinical Affairs and G/CME, University of Illinois College of Medicine at Urbana-Champaign
Normand Paquin, PhD	Associate Director for Research, Coordinated Science Laboratory University of Illinois at Urbana-Champaign

Interviewees	Organization
Dan Peterson, JD	Vice Chancellor for Institutional Advancement and Senior Vice President University of Illinois Foundation
Partha Ray, MD	Surgery/Surgical Oncology Carle Foundation Hospital, Founder Oracle Bioscience Carle Foundation Hospital
Norbert Riedel, PhD	President and CEO of Naurex, Illinois Innovation Council
Warren Ribley	Executive Director, Illinois Medical District Commission
Sara L. Rusch, MD	Regional Dean, College of Medicine University of Illinois College of Medicine at Peoria
Peter Schiffer, PhD	Vice Chancellor for Research University of Illinois at Urbana-Champaign
James Slaugh	Professor and Director, Medical Scholars Program, University of Illinois at Urbana-Champaign
Rick Stephens	Chairman of Horizon Hobby Community Relations Lead for the College of Medicine
Magesh Sundaram, MD	Surgical Oncologist, Biomedical Research Center Carle Foundation Hospital
Rich Tapping, PhD	Associate Dean for Research UIC College of Medicine at Urbana
Molly Tracy	Associate Vice Chancellor for Institutional Advancement University of Illinois at Urbana-Champaign
John Vozenilek, MD	Chief Medical Officer, Jump Trading Simulation & Education Center Chief Medical Officer for Simulation, OSF Healthcare
Phyllis Wise, PhD	Chancellor University of Illinois at Urbana-Champaign
Jennifer Woodard, JD	President and Director of Strategic Engagement Illinois Medical District Commission

APPENDIX B: EXAMPLES OF BIOTECHNOLOGY SPINOFFS

The following provide more details on examples of biotechnology spinoffs generated by faculty at the University of Illinois at Urbana-Champaign.

- Diagnostic Photonics, a company founded by two University of Illinois at Urbana-Champaign Electrical and Computer Engineering Professors, developed an imaging technology that generates diffraction-corrected images of tissue microstructure by solving the mathematical equations governing the physics of light at high speed and transforming defocused images into in-focus ones. This approach brings imaging to the point of care and places the power of optical imaging in the hand of the physician. Clinical trials with breast cancer patients have been completed with Carle and Johns Hopkins University.
- MC10 is commercializing products in wearable systems, home diagnosis and remote monitoring, and medical devices based on the pioneering inventions of stretchable and flexible silicon-based electronics developed by a University of Illinois at Urbana-Champaign Professor. MC10 is producing interventional catheters with ultra-low profile, nanometer-thin sensors that deliver real-time feedback to physicians during procedures. MC10 is backed by investors such as North Bridge, Braemar Energy Ventures, Aberdare Ventures, Windham Venture Partners, TERAWATT Ventures, and Medtronic Ventures.
- Daktari, which utilizes technology developed by a University of Illinois at Urbana-Champaign Bioengineering Professor, employs CD4 counting technology for point of care diagnosis and treatment of HIV and Hepatitis C. The company has raised $30 million in venture capital and employs 55 people.
- Metabolomx, co-founded by faculty at the University of Illinois at Urbana-Champaign, has developed technology enabling the identification of lung cancer from a patient's breath. The technology, based on a breath analysis system, is a novel, proprietary colorimetric sensor array. The company has partnered with the Cleveland Clinic.
- Glucosentient, founded by a University of Illinois at Urbana-Champaign Chemistry Professor, developed a technology that transforms personal glucose meters into devices that quantitatively and conveniently detect non-glucose targets.
- Oracle Biosciences is developing a single gene-based clinical assay for diagnosis and prognosis for basal-like breast cancer for use in clinical diagnostics and subtyping. Research is being completed at Carle.
- Phi Optics, Inc., founded by a University of Illinois at Urbana-Champaign Electrical and Computer Engineering Professor, is an optical microscopy company that developed a disruptive technology –

Quantitative Phase Imaging (QPI) – that provides highly accurate, fast, and inexpensive imaging of live cells and tissues.

- Exalt Diagnostics, founded by a University of Illinois at Urbana-Champaign Bioengineering, Electrical and Computer Engineering Professor, developed FluoroBoost, a technology that measures the presence and concentration of dozens of proteins circulating inside the human body. The technology utilizes a nanostructured photonic crystal surface to increase the output of any surface-based fluorescence assay by more than 500 times.
- Accelerated Genomics, founded by researchers from the University of Illinois at Urbana-Champaign's National Center for Supercomputing Applications, Institute for Genomic Biology, and the Department of Computer Science, accelerates the performance of gene alignment and sequencing through algorithms and the use of graphics processing units (GPUs). The technology enables the processing of genomic data at a rate four to six times faster than previous technology.
- Paxent LLC, founded by a University of Illinois at Urbana-Champaign Computer Science Professor, is collaborating with Carle on health care data analytics based on outcomes of the Strategic Health IT Advanced Research in Security (SHARPS) and related projects in health information technology.
- Phonticare, founded by an MD/PhD Electrical and Computer Engineering Professor at the Beckman Institute, is developing a line of portable biomedical optical imaging products using optical coherence tomography (OCT), a non-invasive optical imaging technique capable of providing high-resolution three-dimensional images of tissue structure in real-time.
- Vitruvian Biotech, founded by a University of Illinois at Urbana-Champaign Bioengineering faculty member, is developing image-guided targeted nanoparticle drug delivery. The initial research was completed at the Carle Biomedical Research Center, a collaboration between Carle and the University of Illinois at the Mills Breast Cancer Institute.

APPENDIX C: TRIPP UMBACH QUALIFICATIONS

Tripp Umbach is a national leader in feasibility analysis, economic impact studies, and consultation services for universities, hospitals, academic medical centers, and biomedical organizations. Tripp Umbach has provided consultation and economic impact analysis services for more than 50 medical education expansion clients, and for virtually every college of medicine that has been created or expanded during the past 10 years. Since 1995, Tripp Umbach has completed national studies measuring the economic impact of all allopathic medical schools and more than 400 teaching hospitals for the Association of American Medical Colleges (AAMC), making Tripp Umbach the most qualified firm to assess the feasibility and economic impact of a new or expanded college of medicine or hospital campus. In 2013, 50 of the top 100 academic medical centers ranked by *U.S. News & World Report* were active clients of Tripp Umbach. Tripp Umbach has completed individual studies for more than 75 established academic medical centers, 500 hospitals, and more than 200 universities since 1990.

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